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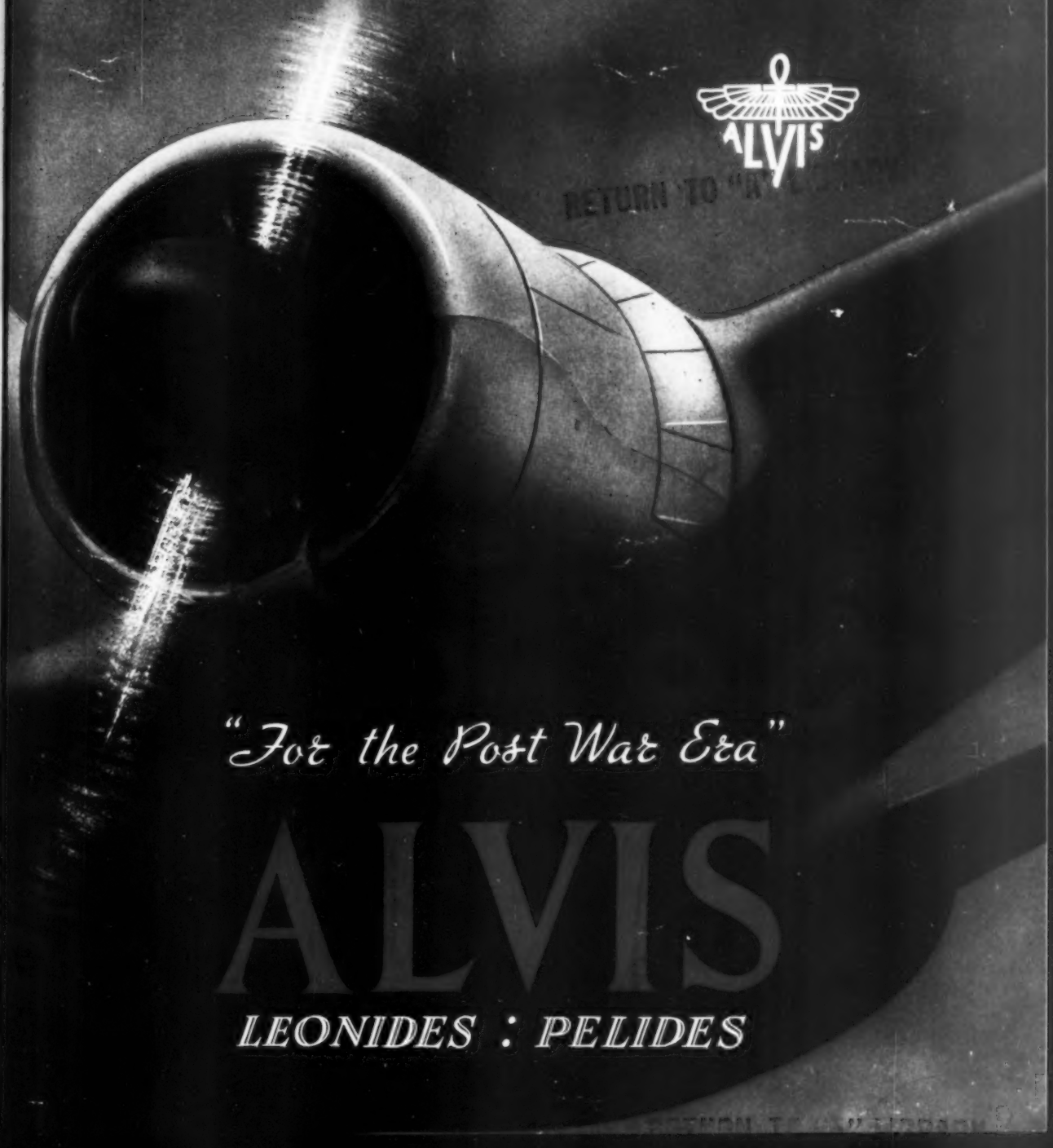
FLIGHT

and
The AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

JULY 22nd, 1943



"For the Post War Era"

ALVIS

LEONIDES : PELIDES

Lancasters v. U-boat base

FLIGHT
and
The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

The Fighting Fortress

SPECULATION as to the reasons for the success of the American Flying Fortresses in bringing down enemy fighters has taken many forms during the last few months. It has ranged from the assumption that the numbers claimed could not possibly be correct, in view of the much more modest claims made by the Royal Air Force, to the argument that the method of operation explains everything. As usual in such cases the truth is probably somewhere between these two extremes.

Let us agree at once that not even the most severe critics (and it would be idle to deny that they exist) have questioned the good faith of the American crews. The argument has been that with a formation of Fortresses flying close together, as they do, it must be almost impossible to determine which gunner hit any particular enemy fighter, especially when, as is usually the case, the fighters attack from many points and in quick succession, not to say simultaneously. The rule in the Royal Air Force is that no enemy aircraft is claimed unless it is actually seen to hit the ground or sea, and seen by more than one watcher. At the height at which the Fortresses are flying, and in the heat of the battle, the doubters argue, it must be difficult to obtain such severe checking.

Probably the R.A.F. system errs in the opposite direction, and more enemy aircraft are destroyed than are actually claimed. There have been cases when the Germans themselves have admitted greater losses than we have claimed. In the recent attack on Le Bourget and Villacoublay the Fortresses claimed 45 enemy aircraft for the loss of eight bombers and four fighters, while the German communiqué gave very different figures.

In his broadcast talk on Sunday last Mr. Peter Masefield had much to say about the accuracy of the bombing of Le Bourget, and he referred to attacks by enemy fighters, one of which hit the Fortress in which he was flying, but he made no reference to having seen any fighters brought down. On the same day Typhoon fighter-bombers bombed the airfield at Tricqueville; they reported no enemy fighters in their sector.

At a press visit to an American bomber station in this country some interesting facts and figures were given concerning the way in which the U.S. Eighth Army Air Force works and the results obtained. Close formation and the location of the armament in the Fortresses combine to form a "porcupine" which the enemy finds it extremely difficult to damage. The defensive armament is, as our readers will be well aware, in the form of machine guns, mostly the famous "point five." The number of guns varies but is never less than 11 and mostly 13, so that the fire power of each aircraft is in the neighbourhood of 8,000 rounds per minute. The Fortress carries very nearly the same weight in the form of ammunition as that of its bombs, that is to say, about 2,000 lb. These figures, coupled with the system whereby a reserve aircraft is ever ready at the tail of a formation to take the place of any brought down or forced out of the formation, give an indication of the formidable defence which the Fortresses possess.

Another reason for the success of American air gunnery was disclosed at the Press visit. The Sperry computing gun sight, a picture of which will be found on p. 86, automatically makes allowance for the speed, range, and size of the target, and works out trajectory and deflection, so that when the gunner sees in the optic head the spot on the target at which he should fire, all he has to do is to press the trigger.

The U.S. Eighth Army Air Force claims that Flying

Fortresses, in daylight raids on Europe, have brought down more than 1,100 enemy aircraft for an ammunition expenditure of about 300 tons, or something over 6½ million rounds. That appears to work out at more than 6,000 rounds fired for each aircraft brought down.

The Truman Report

SEVERAL very interesting facts emerge from such fragments as have reached this country of the report on American aircraft production by the Truman sub-committee of the Senate. Certain allegations of inadequate engine inspection at the Lockland, Ohio, works of the Curtiss-Wright Corporation have been vehemently denied by the president of the corporation, as reported on p. 95, and comment must be deferred until all the facts are available.

If the Truman Report has been correctly quoted, it appears to us that it is slightly unfair to the much-discussed and abused Ford Willow Run factory. According to extracts from the report quoted in this country, one passage read as follows:—

> "The production line was set up similar to an automobile assembly line, in spite of the warnings of many experienced aircraftmen. This resulted in slower progress at the beginning, but should result in increased production at a later date, providing there are not too many modifications and changes."

It may appear impertinent of us to venture an opinion without having had an opportunity to inspect the Willow Run factory. We need hardly say that nothing could be farther from our intention; but we have had the view expressed to us by those who have made a close study of Willow Run that there is little to be seen there which is not perfectly normal and orthodox "parent" aircraft factory practice. The automobile influence is seen mainly in the lavish scale of the tooling-up, not in manufacturing methods.

Criticism of the Martin Marauder relates chiefly to its take-off and landing characteristics, which are said to be "difficult" in the hands of other than specially trained pilots. It appears likely that if there had been no other criticism the type would have been continued, but the report refers to it as being costly to produce and maintain, and the combination of these features has resulted in a decision by the U.S. Army to taper off the production of the type.

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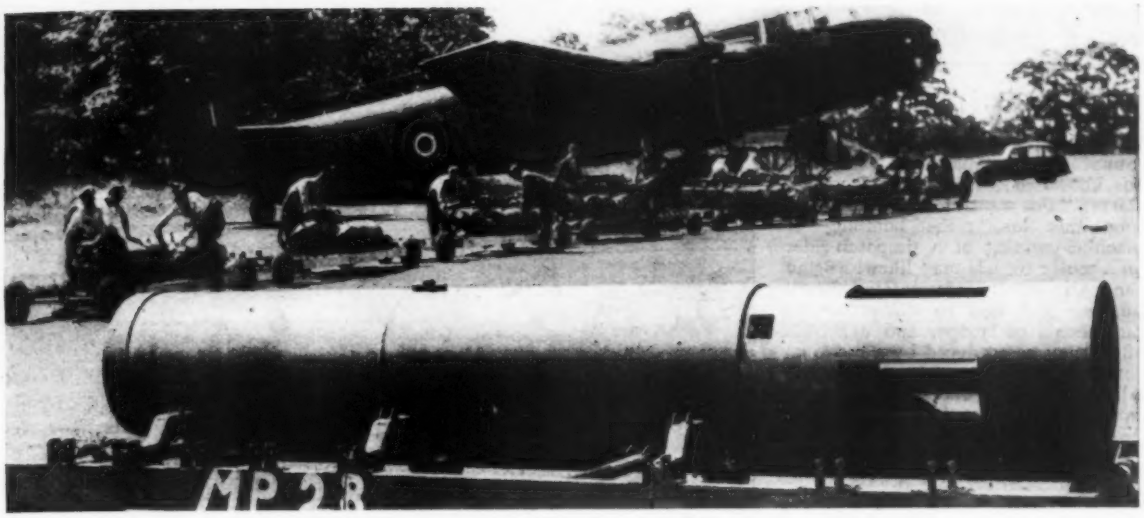
The Dive Bomber

THAT the Truman Committee should have reported that the U.S. Army has decided that it will have little need of more dive bombers need cause no surprise. Experience has shown that against ground targets the dive bomber is vulnerable unless it has complete air cover and the ground targets are inadequately equipped with anti-aircraft defence. The report states that "the programme will be greatly reduced, both because of the Army's opinion that the dive bomber is not valuable for most Army purposes and because of the inability of the company to date to produce usable planes."

The U.S. Navy does not quite agree with the Army about dive bombers. That, again, is scarcely surprising. The dive bomber has given good results against targets at sea, although, as the report states: "'Skip bombing' may prove to be more satisfactory than dive-bombing." The Navy, therefore, is still of the opinion that it should continue its dive-bomber programme. The committee appears to be in some doubt.

In the series of articles on dive bombers which began in our issue of June 10th this year "Helldiver" challenged the view that the dive bomber is dead. He came to the conclusion that improved types might change the picture.

SAVING THE SINKERS: An R.A.F. Catalina picking up the crew of a Coastal Command Fortress who had been forced down on the Atlantic six days previously after sinking a U-boat. During the long Air/Sea Rescue search a U.S. Navy Catalina was wrecked while trying to alight.



CONCENTRATED BLITZ : One of our new blast bombs waiting to be loaded up at a Halifax station.

WAR in the AIR

Airborne Troops in Sicily : Axis Hesitating Defence : Beaufighters as Bombers : Russia Counter-attacks

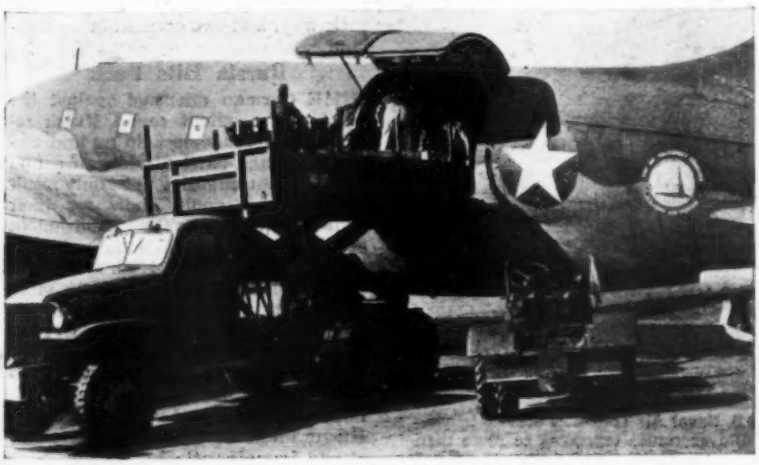
EVENTS in Sicily have moved so fast that it is not possible for a weekly paper to keep pace with them and to comment on all the developments which the public will have learnt from the daily papers. As we write, all has been going well for the invading Allies, though a rumour (not officially confirmed) has got about that a nasty wind interfered with the landings of the parachute troops on the night before the seaborne forces reached the beaches, and that this prevented the former from accomplishing all that was hoped from them. The enemy claimed that the "parachute "gangsters" had been dealt with by his own ground troops, but he would be sure to say that in any case.

One glider (Horsas were the type used) certainly came down in the sea among the ships which were approaching the shore before dawn, but the soldiers extricated themselves and swam towards the ships. They called out to the ships to pick them up, and when the Navy shouted out to ask them who they were the swimmers replied "Airborne," a description which recalls an expression of Mr. Churchill in his early days—"terminologically inexact."

Other parties of air-landing troops, though their Horsas had not landed close together, made for an important bridge outside Syracuse and gallantly captured it. They were presently overwhelmed by superior numbers, and after losing rather heavily were taken prisoners. Their captivity lasted only a short while, for within an hour the advancing British infantry from the beaches reversed the situation by capturing the Italians and setting their prisoners free.

During the first days of the advance the enemy took no strong action to oppose the Allied troops. It was natural and right that the General in command of the defences should hesitate to commit his reserves until the situation had been clarified. He would naturally be in doubt as to whether Generals Eisenhower and Alexander had further landings on other parts of the coast in mind, and to send all his reserves to the south east would leave the western shores of the island unprotected.

At the same time it is quite probable that the hesitation of the Italians (for the Germans in the island are a minority) may have been largely due to the bombing by the Allies of the headquarters and post office at Taormina. Added to that, the continuous attacks of the Allied aircraft on communications all over the island may



ALLIED UPLIFT : How Air Transport Command of the U.S.A.A.F. gets over the problem of high loading into the Curtiss Commando.

WAR IN THE AIR

well have left the Italian High Command in ignorance of what was going on, and without information a General cannot take suitable action. Everyone knows the pregnant jingle which starts: "For want of a nail the horseshoe was lost"; the bombing or machine-gunning of a despatch-rider on a motor bicycle may likewise delay the taking of vital information to headquarters and lead to delay in the movements of troops, and a similar effect may be produced by a bomb on some wireless transmitting set. The Allied command of the air has certainly handicapped the Axis staff very heavily.

The Captured Ports

IT must have been a very welcome surprise to the Allied leaders to find the ports which they captured in their first dash, notably Syracuse and Augusta, scarcely damaged and in good condition for use by the Royal Navy and the transports. They had been bombed a good many times by the R.A.F. and U.S. heavy bombers, but everybody knows that it takes a tremendous lot of explosive to put a port out of action. The Axis ports in Libya had suffered very heavily, and it took a lot of work to clear them, but fortunately the same labour and time will not have to be expended on Syracuse and Augusta. This was a very important matter, for an invasion cannot be expected to progress healthily unless the invaders capture a port with good facilities for landing all the heavy cargoes needed by a modern army.

The coast defence battalions of Italians put up a feeble resistance, as was expected, but the Italian field divisions fought much more stoutly in defence of their own soil than they had usually done over the sea in Africa. This also had been expected. Nevertheless, Canadian troops captured the commander and staff of the 54th Naples Division, and in the first six days of the invasion 12,000 prisoners were taken by the Allies, which, as the Algiers correspondent of *The Times* pithily remarked, is proof that our advance had been opposed with some prodigality of men if not of talent.

The authorities in Italy seem convinced that their mainland country will be invaded next, and have thrown out strong hints that it is time Germany sent larger reinforcements. A Vichy broadcast replied that all available Axis reserves were already fully engaged. Has Hitler at last concluded that Mussolini is not an asset but a liability, and decided to leave him to stew in his own juice?

CELESTIAL GIFT: Three of nine aircraft presented to the Chinese Central Government at Chungking from the proceeds of the Dollar Fund. They are North American N.A.16s, which are variants of our Harvard trainers.

Beaufighter Bombers

THE confusion in the minds of the Axis is doubtless increased by the activities of the Middle East aircraft in the Ægean Sea, and it has been made known that much of the damage done by the long-range fighters of that Command has been effected by Beaufighters carrying bombs. They have been known as torpedo-aircraft for some time past, and now they are proving very useful in a new role.

Very impressive is the way in which Bomber Command in Great Britain has been able to lend a hand to help the Mediterranean forces. Despite the shortness of the summer nights, heavy bombers from Britain made the long journey to Turin, and they concentrated their attacks, not on the Royal Arsenal or factories, but upon the railway station, through which reinforcements from France would mostly have to pass on their way to Southern Italy. Another raid on the railway junction of Aachen was probably also intended to dislocate Axis communications, and might have a bearing on either the Sicilian or the Russian front. Unfortunately, some of the bombers returning from Turin by a roundabout way seem to have lost their way, and two crashed in Switzerland.

SHIPPING IT GREEN: A Catalina of the U.S. Naval Air Transport Service taxying in heavy weather. The U.S.N.A.T.S. operates over routes extending to more than 50,000 miles.

Russia Hits Back

THE German offensive against the Russian salient round Kursk resulted in very fierce fighting and tremendous tank battles, while air action went on continuously. The only result the Germans could show for their enormous losses was the establishment of a wedge in the direction of Bielgorod. The Russian High Command met this limited onslaught with great sang-froid, and as the German impetus died away they struck back towards Orel, to the north of the salient. Their tanks went into action with strong air cover, and their bombers raided focal points behind the enemy lines.

The counter-attack fits in very

WAR IN THE AIR

nicely with the Allied invasion of Sicily.

The battle for Catania developed into a fiercely fought affair, with the best German troops in the island trying to hold back the Eighth Army. Though the plain outside the city is much broken up by streams, Axis tanks were brought into action, and used to the extent that was possible. All the time the aircraft of the United Nations bombed military targets round the city, and last Saturday a British battleship approached within five miles and blew the barracks in the place to smithereens with salvoes of her heavy guns. Axis artillery had been brought up on the shore and attempted to reply, but was engaged successfully by the British destroyer screen. Two enemy fighters were all that made their appearance during this action. Air attacks all over the island continued without cessation by day and night, and went far towards paralysing the coherent defence of Sicily by the Axis.

Saturday also saw the heaviest attack to date on Naples. Over 500 heavy and medium bombers poured down tons of explosives on the Royal arsenal, railway yards, and a torpedo factory. Enemy fighters put up a show of resistance, and though only one Allied machine failed to return from all the operations of the day (and it is not stated that this was lost over Naples) the claim to have shot down 21 enemy aircraft shows that the defence was not devoid of spirit. Night attacks on Naples were also made.

Rome was bombed in daylight on Monday last by heavy and medium bombers. Warnings had been given by wireless and by dropping leaflets. The raid was aimed at the important railway shunting station. The aircrews had been specially trained, and were emphatically briefed to avoid damage to religious and cultural monuments.

BRITISH & U.S. AIR LOSSES to JULY 17th

	Over G.B. A'crft.	Continent B'brs.	Continent F'trs.	Middle East A'crft.	N.W. Africa A'crft.
July 11	0	0	2	0	9
12	0	13	2	1	11
13	0	20	0	0	7
14	0	0	2	1	3
15	0	7	7	1	7
16	0	0	0	1	4
17	0	2	1	1	12
	0	42	14	5	53

Totals: West, 6,786; Middle East, about 2,114 North West Africa, 912.

The War with Japan

IT is surprising to read of the number of successful air actions carried out by the R.A.F. and Americans in India against the Japanese in Burma during the monsoon. Of course, there are always breaks at times in every monsoon, but the meteorologists must have many a headache in calculating when it is reasonably safe for our aircraft to set out over jungle and hills which would give the crews little chance of survival if things went wrong.

Bombers of the American Army Tenth Air Force, based in India, have knocked another span out of Myitnge railway bridge, south of Mandalay, which should make through traffic impossible for a long time, and so cut off the Japanese in northern Burma from rail communications with the southern part of the country.

ENEMY AIR LOSSES TO JULY 17th

	Over G.B.	Continent	Middle East	N.W. Africa
July 11	0	0	3	45
" 12	1	1	0	28
" 13	2	3	0	42
" 14	0	4	0	9
" 15	1	10	0	16
" 16	0	3	11	13
" 17	1	0	21	18
	5	21	35	171

Totals: West, 7,114; Middle East, over 5,478; North West Africa, 2,523.

WILD HORSES: Mustangs of the new Tactical Air Force on the tarmac. For close support work with the Army the Mustang is being used both for bombing and reconnaissance.

PRECISION WORK: The oil storage tanks at Leghorn going up in smoke after an attack by the U.S.A.A.F.

General MacArthur's men have pushed on resolutely in New Guinea and New Georgia. His Air Force is still his spearhead, and it is stoutly backed up by his naval and land forces. The Japanese bases at Lae and Salamaua on the northern coast of New Guinea are threatened by combined action of American and Australian troops.

Last Saturday was a brilliant day for the Allies in the Pacific as well as in the Mediterranean. After a night of bombing of the neighbouring enemy airfields by Fortresses and Liberators, a force of 200 aircraft set out to attack Japanese shipping lying between Buin and Faisi in the northern Solomons. This was a very large air armada for that part of the world, and shows that General MacArthur's strength has been growing. The attack lasted only 20 minutes, and was concentrated in the manner which has been learnt in the West to be most effective. Seven enemy ships were sunk, four of them warships, and others were damaged. An intense air battle took place overhead, in which the American pilots claimed to have shot down 49 Japanese machines for the loss of only six of their own. The U.S. Navy has also asserted its superiority in some small but vigorous actions against Japanese cruisers and destroyers.

HERE AND THERE

Sir Stafford Cripps Resting

ACTING on medical advice, Sir Stafford Cripps, Minister of Aircraft Production, is at present taking a fortnight's rest. He returns to duty on August 2nd.

New U.S. Bomber Chief

U.S. Eighth Army Air Force headquarters have announced that Brig. Gen. Frederick L. Anderson has been appointed commanding general of the Eighth Bomber Command.

Seasoned Squadron

ONE of the first R.A.F. units to bomb Germany has now arrived in India as a dive-bomber squadron.

Don't Look Now!

WHEN R.A.F. machines pass over Bruges, the people of that city have been in the habit of watching, but the Nazis have now forbidden them to do this.

Beau-bomber

THE Bristol Beaufighter bids fair to compete with the Hawker Hurricane in versatility, for it was recently announced that besides functioning with torpedoes, it has been successfully used as a long-range fighter-bomber in the Mediterranean area since April.

"Rendezvous"

THIS is the provisional title of a film which the M.O.I., with other British and American authorities, are to make showing the cameraderie and efficient co-operation of the R.A.F. and the U.S.A.A.F. stationed in this country.

Three well-known producers were interested in the project, but the M.O.I. has chosen Sir Alexander Korda.

A WINNING EQUATION: ROLLS + BRISTOL = ROTOL:—Some years ago Rolls-Royce Ltd. and the Bristol Aeroplane Co. Ltd. joined forces in founding the firm of Rotol Airscrews. Seen here are the heads of the three firms. Lord Herbert Scott, R.-R., chairman, in the centre; Sir G. Stanley White, Bristol managing director, on the right; and Mr. R. H. Coverley, Rotol controller, on the left.

The Future

THIS week sees two well-known personalities in the aviation world speaking in London about the future.

Mr. E. C. Gordon England gave a talk on Tuesday evening to the N.E. London Supervisors' Discussion Group, at the South West Essex Technical College, at Walthamstow, on "The Future of Management," and Sir Roy Fedden is addressing a special meeting of the Engineering Industries Association at the Waldorf Hotel this afternoon on "The Future of Engineering."

Baron Dowding

BARON DOWDING of Bentley Priory, in the County of Middlesex, is the title taken by Air Chief Marshal Sir Hugh Dowding, upon whom a barony was conferred in the Birthday honours.

New U.S. Fighter Aircraft

IT was recently stated by Mr. Charles Wilson, vice-president of the War Production Board in America, that the newest U.S. "secret super fighter" aircraft are now in production and rolling off the assembly lines.

A subsequent statement by the American authorities indicates that Mr. Wilson was referring to the U.S. Navy's new carrier-fighter, to be known as the Hellcat, a development of the Grumman Wildcat, which is basically the same aircraft as the Fleet Air Arm's Martlet.

Apart from the statement that the Hellcat has "a more powerful engine and armament, which includes a battery of 0.5in. machine guns," no details of the new Navy fighter have yet been released for publication.

Blind Aircraft Workers

ALTHOUGH it is common knowledge that thousands of blind persons have been trained in a variety of crafts, chiefly by St. Dunstan's, it is not so generally realised that they can do, and are doing, extremely useful work in engineering, including aircraft production.

An excellent article in the current issue of *Production and Engineering Bulletin* deals with this subject and lists more than 120 jobs at which blind persons are now being successfully employed—and the list is constantly being extended.

Blind workers, the article points out, often show remarkable powers of concentration on the job because they are not distracted by workshop incidents which distract the attention of the sighted worker, and, moreover, their unusual sense of touch and hearing frequently prove to be assets.

So Now You Know!

THE following definition, recently received from a *Flight* reader, may be used for testing lung capacity. Try if you can say it in one breath.

> An aeronautical engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulæ calculated with micrometric precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopelessly chimerical group of fanatics referred to altogether too frequently as aircraft designers.

MECHANICAL MARKSMAN: Accurate shooting by Flying Fortress gunners is largely credited to the Sperry Computing Gunsight, one of which is here seen in the hands of armaments officer Lt. W. R. Cain (Indianapolis) and tail-gunner S/Sgt. Milton Edwards (Laurel, Maine). It is, in effect, a semi-automatic predictor and weighs 60lb.

Germany's Naval Aircraft

Early Developments : Flying Boat Designs : Diesel Power Plants : Comparison with Allied Types

By V. L. GRUBERG

REAR PROTECTION : The gunner in the upper turret of the B.V. 138 flying boat, a type widely used by the *Luftwaffe* in the Baltic, the North Sea and over the Arctic.

FOR practical purposes the development and construction of German sea-going aircraft may be said to date back to the years immediately following the conclusion of the last war. During that time most of these types have been described and illustrated in *Flight*; some repetition of details is, however, unavoidable in the present review, which is confined to the representative types of German naval aircraft and their comparative qualities.

The foundations for this development were laid by Dr. C. Dornier, who was originally associated with Count Zeppelin in the construction of airships; his flying boat and seaplane designs, originally destined for the *Lufthansa*, have remained the mainstay of the *Luftwaffe's* marine aircraft equipment to the present time.

Between 1914-18 Dr. Dornier developed the Do RS1, "a giant flying boat" powered with three 145 h.p. engines. It had a span of 141ft., a length of 95ft., and a wing area of 3,638 sq. ft. From this flying boat the Dornier "Wal" (Whale) was developed in the early 'twenties. A direct descendant of it was the prototype of the twin-engined flying boat, the Do 18. The Do 18K and Do 18K2 are the military versions of this type in service with the *Luftwaffe*.

The Do 18K, based on the smaller version of the original civil flying boat, the Do 18E, has an all-metal hull divided by transverse bulkheads into eight watertight compartments, and is equipped with a water rudder. It has the characteristic sponsons or "*stummeln*" attached to the hull. They give lateral stability on the water and increase the lifting surface in flight. With an empty weight of 12,265 lb., a military load of 660 lb., and a total disposable load of 9,735 lb., the aircraft has a span of 77ft. 9in., a length of 63ft. 1in., and a height of 17ft. 9in. Wing area is 1,054 sq. ft., and wing loading 20.8 lb./sq. ft. The two Junkers Jumo 205 liquid-cooled diesel engines of 600 h.p., arranged in tandem, give the Do 18K a range of 3,220 miles. The maximum speed of 161.5 m.p.h. can only be considered moderate.

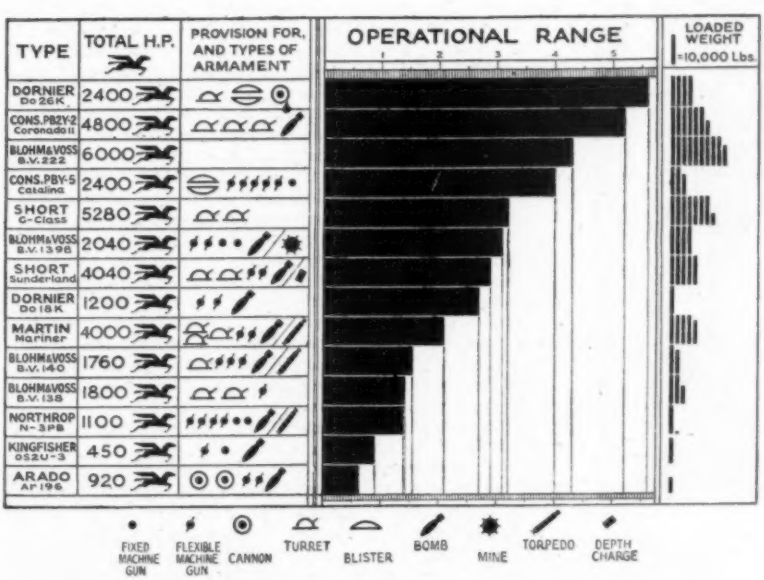
The Dornier Family

On the Dornier Do 18K2 the diesel engines were replaced by B.M.W. 132N air-cooled radial petrol engines of 865 h.p. each, with a consequent improvement of performance at the expense of operational range. The maximum speed at 7,200ft. is 186 m.p.h., and the range 2,700 miles. The increased horse power has also resulted in an improvement in the useful load, bringing the loaded weight of the aircraft up to 30,000 lb., with an increase in the empty weight of only 335 lb. over that of the Do 18K.

In contrast to the Do 18 series, the next type constructed by Dornier, the Do 24, is a high-wing, semi-cantilever monoplane flying boat with a well-faired rear portion of the hull. The sponsons are identical, braced by simple and robust struts to the wings. As in the Do 18, the wing structure is in fabric-covered metal, except for the section in the slipstream of the airscrew, which is metal-covered. The wings are of semi-cantilever type, with the centre section supported above the hull by inverted "V" struts and braced by parallel struts to the sponsons.

The power plant of the Do 24 comprises three B.M.W. 132DC nine-cylinder radial engines of 700-900 h.p., driving three-blade c.p. airscrews. The hull contains, apart from the usual compartment for pilot, navigator and wireless operator, sleeping and rest accommodation for the crew. Accommodation for armament in the bows, aft of wings and in the stern is composed of three rotatable turrets.

The Do 24 has a span of 88ft. 7in.,



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GERMANY'S NAVAL AIRCRAFT

length of 72ft. 2in., height of 17ft. 10in., and a wing area of 1,162 sq. ft. With a loaded weight of 29,700 lb., it develops a maximum speed of 211 m.p.h., and has a ceiling of 18,700ft. and a range of 2,173 miles. The machine was originally designed for transport and for export.

In the initial stages of this war the Do 24 was extensively used in operations against Norway and this country, against Holland and in the Mediterranean.

Flying Boats

Perhaps the best known of German flying boat designs is the Do 26, which is capable of making the journey from Lisbon to New York with a substantial payload and without alighting. The Do 26 is a high-wing cantilever long-range flying boat powered with four Junkers Jumo 205 liquid-cooled diesel engines of 600 h.p. each. It was clearly the intention of the designers to combine in this type the qualities of a seagoing craft with the performance of a landplane, and a close approach to such "balanced" qualities has been achieved.

The engines are mounted close together in tandem nacelles. While the installation of the tractor airscrews of the front engine is orthodox, the rear engines drive pusher airscrews through extension shafts, as on the Do 18, but feature a special tilting arrangement which is the subject of a Dornier patent. The entire rear power plant group can be pivoted 10 deg. upwards, representing a raising of the airscrew hub of about 15.7 in. (40 cm.). The axis of the tilting is exactly below the rear spar. In taking off in a rough sea the rear engines are tilted upwards to keep the airscrews clear of the water spray. In flight their axis is restored to a position parallel with that of the front engines, which permits the maintenance of a streamlined shape of the engine nacelles. The radiators are installed in the wings on the sides of each of the nacelles, and fuel tanks are mounted in the interior of the hull. Front armament is provided in the bows by an electrically operated gun turret mounting a 23 mm. cannon. There are two blisters on the hull.

Apart from the engine installation mentioned above, a departure from the usual Dornier practice is the replacing of sponsons by stabilising wing floats retracting inboard flush with the under surface of the wings. The Do 26 has an empty weight of 22,450 lb., a loaded weight (catapult launch) of 44,090 lb., giving a wing loading of 34.2 lb/sq. ft. and power loading of 18.4 lb./h.p. Maximum speed is 208 m.p.h., but the most striking performance feature claimed is the range of 5,600 miles, the highest yet attained by German seagoing aircraft.

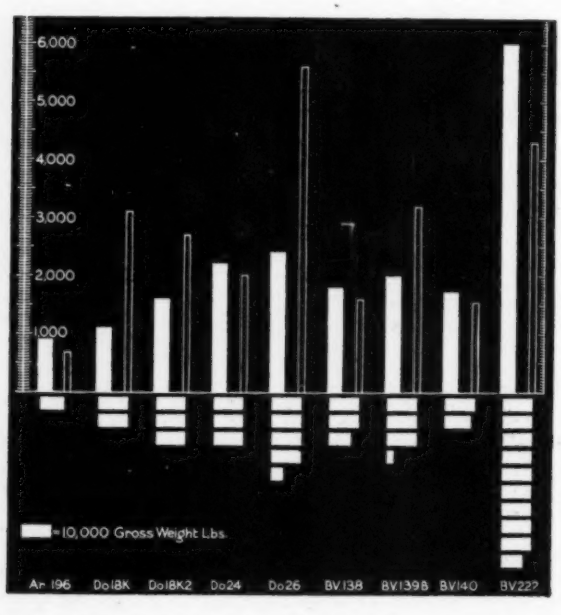
During the past few years the Blohm and Voss Company has gradually come into prominence as builders of seaplanes and flying boats for the *Luftwaffe*. In fact, the Dornier Company has somewhat retired from this field, and the designs of Blohm and Voss have gained predominance in the operational equipment of Germany.

In 1936 the B. and V. company produced the prototype of the BV 139, a four-engined, low-wing, cantilever, twin-float seaplane, originally designed for transatlantic service. Two machines of this type completed fourteen flights from the Azores to New York in the course of the summer and autumn of 1937. With the outbreak of war the BV 139 was modified for military work, and has since been in service with the *Luftwaffe* for transport, reconnaissance and minelaying duties, mainly in the Baltic area.

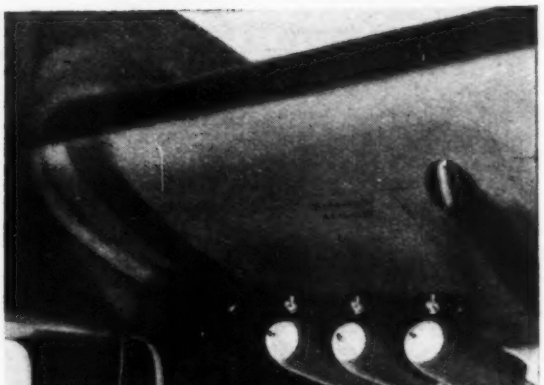
The monocoque fuselage is constructed of the usual transverse frames and longitudinal stringers, with flush-riveted smooth skin covering. The long slim fuselage has in the rear a short stub fin integrally built in, upon which the tailplane is mounted, braced to the fuselage by parallel steel tube struts. Bulkheads are built up of open channel sections, while the main frames are of box section. The wing centre section, of "inverted gull" type, slopes down at negative dihedral to the inboard engine nacelles. Wing structure and attachment to fuselage is in the typical Vogt manner, as described later under the BV 138. The tail unit is of monoplane type with twin fins and rudders. The tailplane is of two-spar construction with channel-section ribs and flush-riveted smooth sheet covering. It is mounted on a short stub fin. The tailplane is adjustable on the ground, and trimming in the air is by tabs on the elevator. The latter has a U-shaped spar, metal-covered nose and fabric covering aft of spar.

The structure of the floats is based on a central fore-and-aft partition extending almost throughout the length, except the front and rear sections. There are seven watertight bulkheads. For inspection and maintenance purposes access is provided through front and rear compartments, and from there, by removing manhole covers in the bulkheads, to each of the compartments.

The BV 139 is powered with four Junkers Jumo 205



The diagram shows the characteristic features of different types of German naval aircraft. Solid white columns indicate total power output, lined columns show ranges.



FOR ARMED RECONNAISSANCE: The B.V. 138 carries six bombs in wing racks outboard of the engine nacelles.

compression-ignition engines of 600 h.p. each, driving three-bladed v.p. Junkers airscrews. The machine has a maximum speed of 195.6 m.p.h. and a cruising speed of 161.5 m.p.h. Alighting speed is 71.4 m.p.h., and the service ceiling 12,136ft. The aircraft climbs to 3,280ft. in six minutes, and has a range of 3,100 miles at cruising speed. With an all-up weight of 38,500 lb. (or only 500 lb. more than the Sikorsky S.42 Clipper), the dimensions of the BV 139 are relatively moderate, the span being 88.5ft., length 64ft., height 14ft. 7in., and wing area 1,265.3 sq. ft.

With the experience gained by the designers from the long-distance flights, modifications were introduced which resulted in the BV 139B type. Most of these improvements were primarily of an aerodynamic nature; the engines were placed lower so as to enable the upper surfaces of the engine cowlings to blend better into the upper wing surface, thus ensuring an undisturbed airflow. The radiators were transferred from the float strut fairings to the wing under-surface. For the cooling system the resulting advantage was in the shortening of connections and reduced risk of damage in alighting.

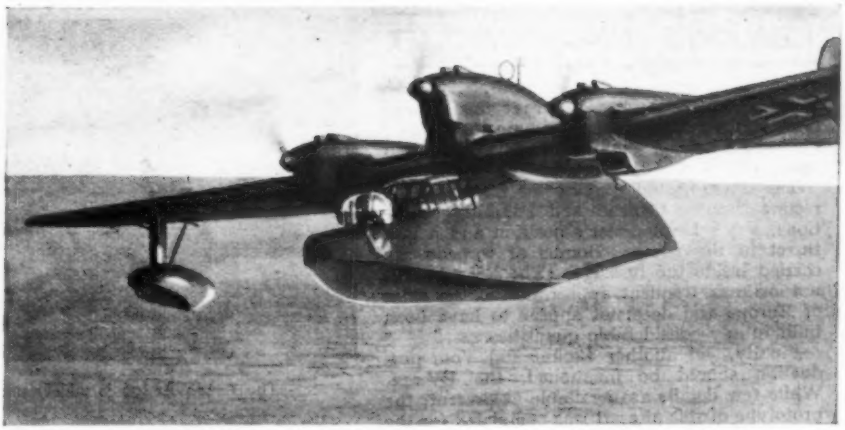
These changes did not produce any material improvement in the speed (about 5 per cent.), but with same fuel consumption an 18 per cent. increase in range at cruising speed was obtained. To enable flight with motors partially out of action, the wing span was increased to 96½ft.

Another Blohm & Voss

The BV 128, a three-engined monoplane powered by Junkers Jumo 205C engines, was the first flying boat constructed by the Blohm and Voss company, and differs considerably in its structural design from the previous German types.

To obtain the best possible field of fire to the rear, the usual method of construction was abandoned, and instead of being carried on the stern of a long hull, the tail surfaces are supported by two cantilever booms growing out of the trailing edge of the wings and tapering to the rear. These booms are placed behind the outboard engines.

This arrangement has enabled the hull to be kept within relatively short dimensions, resulting in good manœuvrability on the water. It has also made possible the provision of two rear gun positions covering the entire space above and below the tail surfaces.



THE "FLYING SLIPPER": The Blohm & Voss BV 138B long-range reconnaissance flying boat designed by Dr. R. Vogt. has an all-up weight of 26,180 lb. and, powered by three Junkers Jumo 205 engines of 600 h.p. each, develops a maximum speed of 171 m.p.h.

The three Junkers Jumo 205 twelve-cylinder compression-ignition engines of 600 h.p. each are arranged in an unusual way. The two lateral engines are mounted left and right on the leading-edge, while the third is placed above the centre of the wing on a vertical streamlined pedestal. The two outboard engines drive three-bladers, the central a four-bladed airscrew to enable a small diameter to be used.

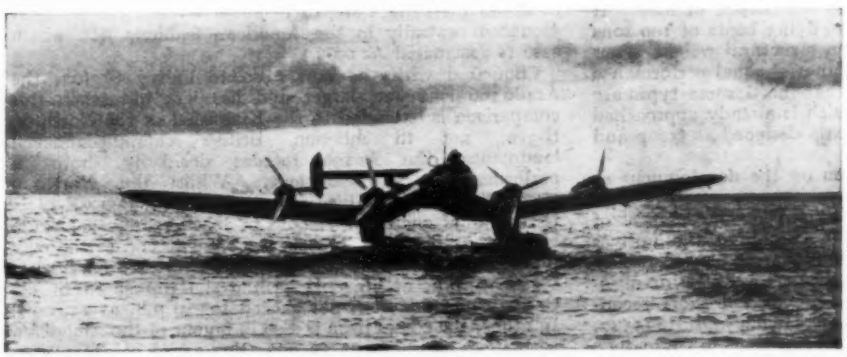
The wing, which is in three sections, is mounted immediately above the hull. The centre section is straight and untapered, while the outer sections are tapered and connected to the centre section at a dihedral angle of 2½ deg. by flange couplings. As in all BV types designed by Dr. Vogt, the centre-section tubular spar is made of chrome-molybdenum steel (rolled to half shells and welded together). In the outboard sections the tubular spar is of riveted Duralplat, and serves also as fuel tank. The centre section is covered with flush-riveted smooth sheet, and the outer sections with fabric. Wings are joined at four points to the fuselage by means of flange plates welded to the tubular centre-section spar and riveted to the main fuselage bulkheads. All-metal outboard floats are mounted under outer wings.

The mooring compartment in the nose of the aircraft has a gun position immediately behind it. The adjoining compartment, allotted for the accommodation of the crew, is raised, and gives a free field of vision over the gun position. Next is a wireless and navigation room followed by an instrument compartment and a rest room for the crew.

With an empty weight of 17,825 lb. and an all-up weight of 26,180 lb., the BV 138B has a span of 88ft. 7in., length 65ft. 3in., and a wing area of 1,205 sq. ft. The wing loading is 21.73 lb./sq. ft. and power loading 13.33 lb./h.p.

The aircraft cruises at 146 m.p.h. and climbs to 3,280ft. in 4.5 min. The maximum speed is 171 m.p.h. and range 1,480 miles.

A development of the BV 139 is the BV 140, a mid-wing cantilever monoplane twin-float seaplane. Powered with two B.M.W.132 DC 9-cylinder air-cooled engines of 880 h.p. each, the aircraft has an empty weight of 13,860 lb., a military load of 1,760 lb., and a loaded weight of 18,700 lb. Wing loading is 19.88 lb./sq. ft., and power loading 11.66 lb./h.p.



The BV 139, known before the war as the *Nordwind*, is one of the *Lufthansa* types modified for military use. It is powered with four Junkers Jumo 205C engines of 600 h.p. each, and is at present employed for mine laying.

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At 80 per cent. power output the BV 140 cruises at 183 m.p.h., the maximum speed being 198.7 m.p.h. and the maximum range 1,550 miles.

The BV 140, employed by the *Luftwaffe* for reconnaissance, torpedo and bombing operations, has a bomb-aimer's position and a gun turret in the nose Bombs or torpedo are carried inside the fuselage. The BV 140 does not make a frequent appearance in the skies of Europe and does not appear to have been built in any considerable quantities.

Finally, yet another Blohm and Voss production should be mentioned, the BV 222. While few details are available at present, the prototype of this aircraft was completed for the *Lufthansa* before the war, but it is only relatively recently that the BV 222 seems to have gone into production. The BV 222 is powered by six B.M.W. 132 DC air-cooled radial engines of 1,000 h.p. each and is said to have a maximum speed of 198 m.p.h., with a cruising speed of 170 m.p.h. and a range of 4,300 miles. With an all-up weight of 97,000 lb. it is the largest flying boat produced in Germany, and falls within the category of the world's "heavy" class.

The Arado Ar 196 is widely used for U-boat co-operation.

From *Lufthansa* to *Luftwaffe*

A characteristic feature of German flying boats is the employment of diesel engines. Out of seven main types, four are equipped with diesel power plants, a fact to which their relatively good range is undoubtedly due. An additional advantage of the lower fuel consumption is the consequent reduction in weight of fuel carried. While operational figures of the *Luftwaffe* are not available, details published by the *Lufthansa* may serve as some guidance. It has been stated that the fuel consumption of the Jumo 205 of 600 h.p. is 62 per cent. of that of a standard petrol engine of equal power output. With four engines of this type the saving on a flight by BV 139 of 16½ hours' duration amounted to 5,214 lb., thus allowing for a considerable increase in useful load.

German experience in the construction of heavy-oil engines has been of great service in connection with long-range aircraft. At the same time it should not be overlooked that this advantage is largely neutralised by the reduced performance in speed. It is significant that the *Luftwaffe* does not use diesel-engined aircraft in the land war. From the point of view of performance Allied flying boats now in service are superior to the German types. In fact, not one of the German flying boats reaches the speed of 285 m.p.h. of the Consolidated Model 31, nor even the 210 m.p.h. of the Mariner I or the Sunderland. Furthermore, only one German flying boat, the BV 222, reaches the gross weight of 35 tons, at which weight the flying boat begins to equal the landplane in the matter of load. If we accept Sikorsky's theory that flying boats of 100 tons gross weight can be built with a structural weight 5 per cent. smaller than that of landplanes of equal performance and disposable load, we realise that the German types are yet far behind this efficiency, which is already approached by a number of Allied flying boats designed as troop and cargo carriers

Perhaps it is the concentration on the development of land power and the ground-bound German strategy that has prevented her naval aircraft from keeping abreast of other equipment of the *Luftwaffe*. Whatever the motives may be, the greater part of the types used by Germany are either adopted from civil transport versions or obsolete, and can only be used for rescue and short reconnaissance duties. Aircraft like the He 114 and He 115K2, even if they do fulfil certain useful functions in Germany's military operations, such as rescue work, minelaying, and reconnaissance, cannot be considered to-day as first-line operational equipment. Frequently landplanes are roped in for any reconnaissance work in which better speed and armament are required.

A further illustration of the rather retarded development of German marine aircraft is found in connection with the equipment of pocket-battleships and armed cruisers. In view of the fact that German experience with catapult-launched aircraft dates back to the war 1914-18, it is rather surprising that Germany should not have made more progress in that particular branch. In the late 'twenties the *Norddeutscher Lloyd* used a rotatable catapult on the liner *Bremen* for launching seaplanes. A Junkers Ju 46 monoplane was in regular service for mail delivery from the *Bremen* and the *Europa*. Immediately after the Anglo-German Naval Agreement of 1935 the Germans applied their vast experience in this line to the equipment of pocket-battleships and cruisers with catapult-launched aircraft.

During the years between the wars the *Lufthansa*, it will be remembered, carried out some highly interesting and, on the whole, successful experiments in the South and North Atlantic with Dornier flying boats which made use of mother ships stationed in the open sea. The flying boats were catapulted off the ships, and were brought on board by taxying up on flexible "aprons" trailed behind the ships. One of these flying boats actually held for a short time the world's distance record for seaplanes by flying non-stop (with catapult start) from the English coast (in Start Bay) to the coast of South America. And yet to-day the main representative of the catapult-launched type is the *Arado Ar 196*, which by no means represents the best in this type of aircraft.

Structurally, the Ar 196 bears strong resemblance to its predecessor, the Arado 95 biplane, and appears to incorporate a modified fuselage and tail unit. It has an all-metal monocoque fuselage with stressed-skin covering, fabric-covered metal wings, elevator and rudder, and all-metal fin and tailplane. The Arado is equipped either with strut-mounted single-step twin floats or with a single float mounted centrally in the American fashion. (In which case is designated Ar 196B.)

Compared with the now obsolete Fairey Seafox, the Arado 196 is faster, larger and heavier; but when this comparison is extended to the Kingfisher or the Northrop N-3PB, not to mention British catapult-launched landplanes, the Ar 196 recedes decidedly, both in performance and armament. While the Northrop N-3PB is powered by one Wright Cyclone R-1820-G-200 radial engine of 1,200 h.p. for take-off, the Arado has a Bramo Fafnir of 920 h.p. and a correspondingly lower performance. The Northrop has a maximum speed of 260 m.p.h. at 16,400ft., while the top speed of the German machine does not exceed 193 m.p.h. at 13,000ft. In range, the comparison is also in favour of the American, with its 1,400 miles at an operating speed of 215 m.p.h. against 670 miles of the Arado at an operating speed of 158 m.p.h.

A comparison of the armament shows relative parity in

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the two types: the Northrop mounts four 0.50in. fixed machine guns in the wings, firing outside the airscrew disc, and two 0.30 guns, one firing to the rear above the fuselage and the other aft through the fuselage belly. The Arado 196A is equipped with two shell-guns mounted in the wings and firing outside the airscrew disc, and two fixed machine guns above the fuselage and one flexible machine gun in the rear.

The lack of faster seaplanes of greater range in the single-engined class is even more striking when one remembers that Germany's main interest in naval aircraft is centred around operations against Allied convoys and ports. In the absence of such types the Germans have to rely on the Arado Ar 196! The relative deficiencies of this aircraft become even more apparent when one considers what importance the Germans attach to their U-boat campaign and the fact that it is precisely as a specialised air weapon in this type of warfare for which the Arado was intended.

It appears, indeed, that in the absence of new developments—due perhaps to replacement of losses of urgently needed landplanes and limits of productive capacity—the system in Germany is to conjure periodically out of the bag some of the lesser-known types of aircraft, and with a concerted fire of publicity bring them into the limelight. A picture of the "new" Arado 196 near a U-boat in his evening paper convinces the German of the omnipotence of his Fuehrer and puts him at ease.

An objective appreciation of Germany's naval aircraft can but conclude that both in the range of types available at present and in types known to be under development or in production, the advantage is decidedly with the Allies.

New K.L.M. Service

Royal Dutch Airlines Extends West Indian Operations

ROYAL DUTCH AIRLINES, one of the world's veteran air carriers, has completed preparations for the first regular direct air service between Curacao, Netherlands West Indies, and Miami, Florida, as recently authorised by the Civil Aeronautics Board in Washington. For security reasons, the exact date of starting the service has not yet been announced.

In view of the importance of the forthcoming inaugural flight, especially to the Allied war effort, the Royal Netherlands Postmaster has announced that the historic event will be commemorated with an official cachet, which will be affixed to all philatelic mail flown on the first flight *from* either or both Curacao and Aruba, but no philatelic mail will be flown from Miami and intermediate points.

Dutch pilots, flying Lockheed aircraft, will maintain a twice-weekly air mail, air express and passenger service, to be covered in one day. Two routes will be flown to Miami, alternating from Curacao and Aruba, by way of either Kingston, Jamaica, Port au Prince, Haiti or Camaguey, Cuba.

The West Indies section of K.L.M. was founded on a modest scale with the opening, on January 19th, 1935, of a service between Curacao and Aruba. But by 1938 there was a veritable network of air routes, linking all important Caribbean countries as far as Paramaribo, Surinam, Dutch Guiana, Colombia and Venezuela, South America, and also providing through connections to Central America and to the east and west coasts of South America.

FIRST FLIGHT CACHETS : The one on the left decorates the special K.L.M. envelope designed for the occasion, and the other is that of the Curacao post office.

NEW ANGLO-AMERICAN DIRECTOR

IT is announced that Mr. Leonard Sinclair has been elected to the board of directors of the Anglo-American Oil Co., Ltd. Mr. Sinclair began his career with the company in Manchester in 1908, and after serving in the last war he held many different positions in various parts of the country. Since 1936 he has particularly interested himself in the business of the company's associates in Europe and North Africa.

THE 1942 "JANE'S"

JANE'S All the World's Aircraft, 1942, compiled and edited by Leonard Bridgman, has now been issued and, in this, its thirty-second year, well maintains the high standard of previous numbers. The price remains at £3 3s.

As the Editor observes in his preface, the task of compiling such a work of reference is one that becomes more onerous as the war progresses, yet in spite of the restrictions inevitably imposed at the present time, the new volume contains some 450 new illustrations, including more than 80 additional general arrangement drawings, besides a considerable amount of new information which has become available since the 1941 *Jane's* was published a year ago.

The volume adheres to the same lay-out as before, being divided into separate sections dealing with the historical aspect, both military and civil, the aircraft produced and/or used by no fewer than 28 different nations, and, finally, the aircraft engines produced by a list of 15 nations.

One can well imagine the enormous amount of painstaking work involved in preparing a volume of this magnitude, especially as complete accuracy must always be the primary consideration, and Mr. Bridgman is to be congratulated upon once again delivering the goods, in spite of all kinds of harassing wartime difficulties.

A GEODETIC R.D.I.

REALISING the anomaly that there was in industry no hall mark of distinction corresponding to that of the title of R.A. in art, the Royal Society of Arts created in 1938 the distinction of Designer for Industry (R.D.I.). The other day it was announced that this distinction had been awarded to Mr. B. N. Wallis, assistant chief designer of Vickers-Armstrong's. Thus to Mr. Wallis has fallen the honour of being the first aircraft designer to be chosen for this distinction.

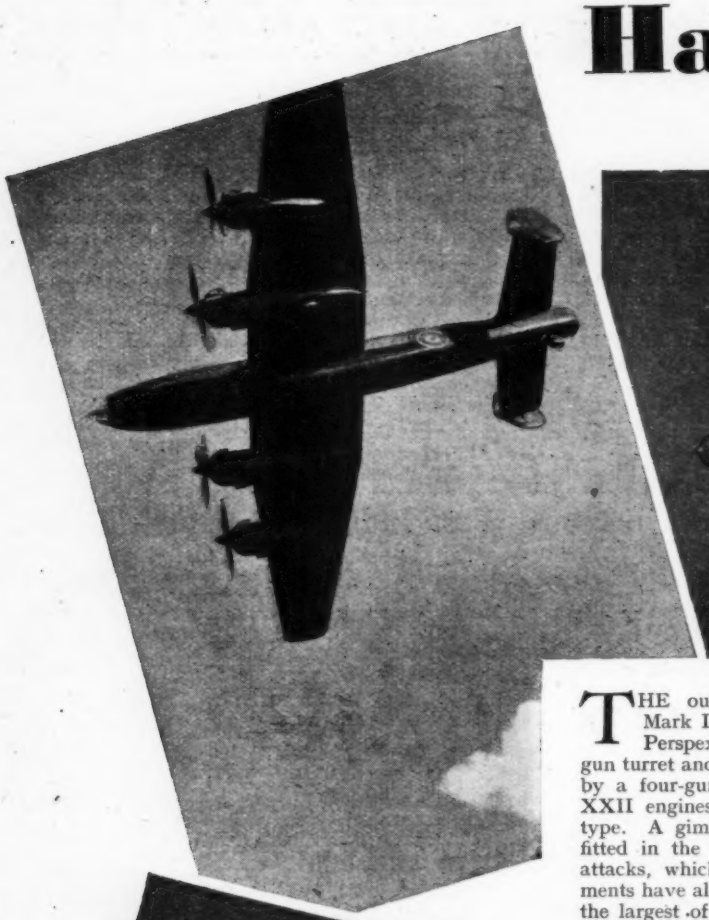
It is not quite clear whether the Royal Society of Arts regarded the geodetic principles of construction applied to aircraft as an art or a science. It is, however, interesting to recall the words of H.R.H. the Duke of Gloucester at the inaugural ceremony in 1938. He said:—

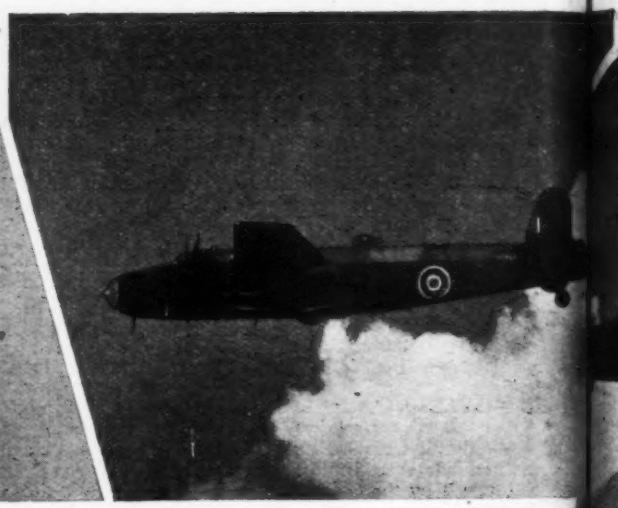
"This distinction, which might be termed the blue riband of industrial art, is intended to be most exclusive and only to be awarded to those who are fully worthy of it. For this reason it is laid down in the ordinance governing the distinction that the number of holders of it at any time must not exceed forty."

It may be added that at present there are only twenty-five who can add R.D.I. after their names.

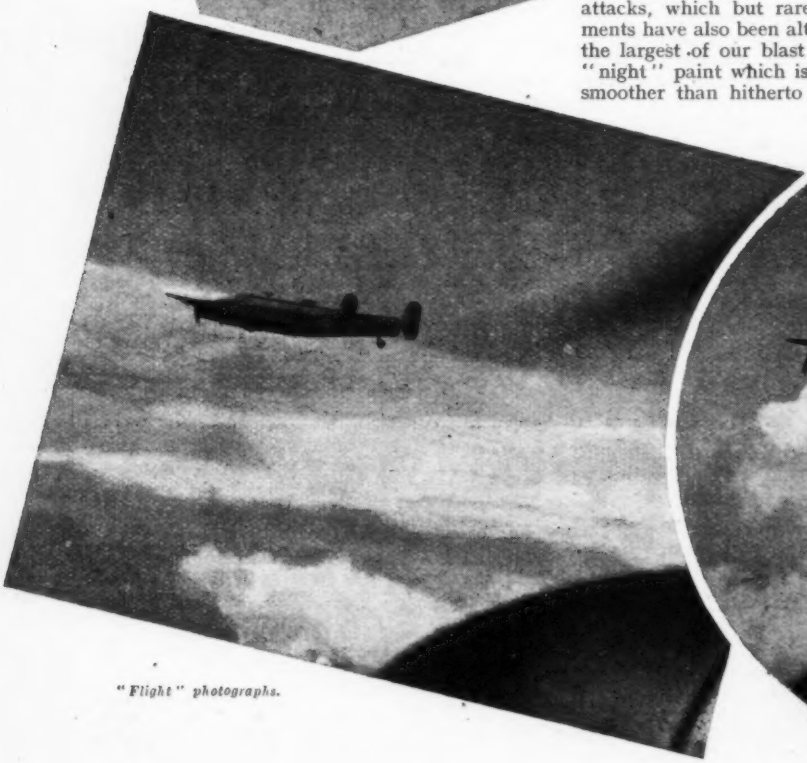
Handley Pa

New Pictures of test





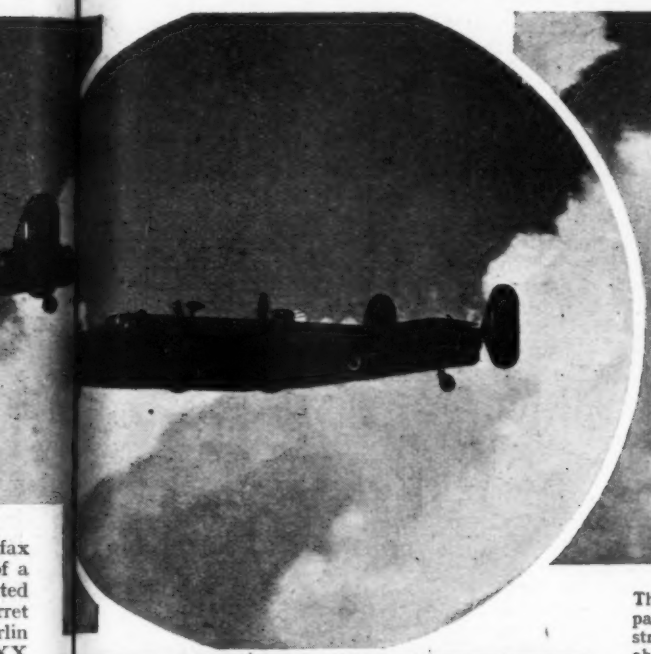
THE outstanding differences between the Halifax Mark I and Mark II are, of course, the fitting of a Perspex nose in place of the front power-operated gun turret and the replacement of the two-gun dorsal turret by a four-gun Boulton Paul turret. Rolls-Royce Merlin XXII engines take the place of the original Merlin XX type. A gimbal-mounted gas-operated Vickers K gun is fitted in the new nose to give protection from head-on attacks, which but rarely develop. The bomb compartments have also been altered in such a manner as to enable the largest of our blast bombs to be carried. The black "night" paint which is such a photographic bogy is now smoother than hitherto to reduce skin friction.



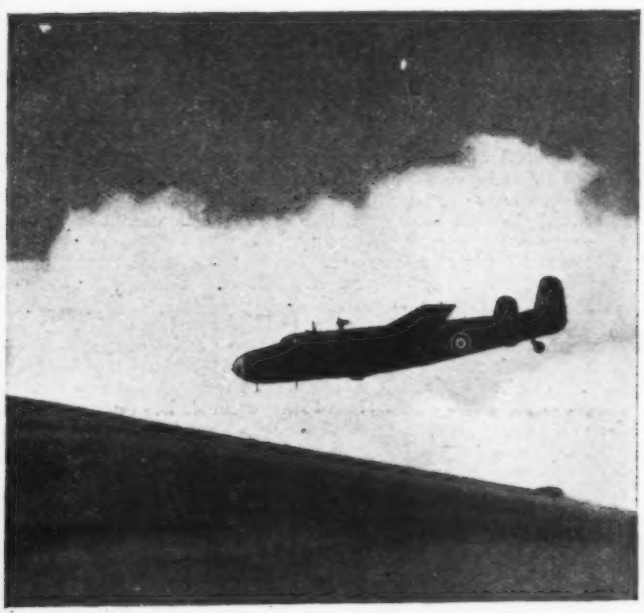
"Flight" photographs.

Halifax Mk. II, 1.A.

...est Edition of One of Our Four-engined Heavies



The top row of photographs, taken as the Halifax approached and passed the photographing aircraft, shows clearly the improved streamline of the new nose. Another difference in outline is the absence of a wireless mast. The aerial on the Mark II 1.A is attached directly on to the direction-finding loop casing.



Three of the lower set of pictures are taken from the conventional "attack" point of view and show the excellent fields of fire of the rear and dorsal four-gun turrets. The Halifax was flown by Sqn. Ldr. Mitchell who is one of the Handley Page test pilots, and the photographs were taken from a De Havilland Mosquito in the hands of Sqn. Ldr. Cox.

Thermocouple Plugs

Heat Conduction Research Work in the Lodge Laboratories

IN their research laboratories at Rugby, Lodge Plugs, Ltd., have been making investigations into the temperatures of the insulators and electrodes of sparking plugs during actual operation under test-bed and road service conditions in various types of internal-combustion engines. The information so obtained has proved of considerable value, not only in the design of sparking plugs, but in connection with engine design and development. The measurements are obtained by means of special sparking plugs incorporating very fine thermocouples, which, in conjunction with a millivoltmeter, enable the temperature to be recorded whilst the plug is in actual operation in the engine.

The investigations originated in connection with the development of sparking plugs for aircraft engines, but were subsequently extended to engines used in motor cars and road transport vehicles generally. The comparatively simple design of standard plugs, as compared with modern aero plugs, makes the technical problem of introducing thermocouples much easier, and much of the fundamental information obtained is of general application.

Measurements with thermocouple plugs have shown that the hottest point in a plug of standard design is the tip of the central electrode where the spark occurs, and that pre-ignition takes place if the temperature of this electrode reaches 1,100-1,150 deg. C., the exact temperature depending on various factors such as compression ratio, type of fuel, etc.; after-running, or auto ignition, will occur at a temperature about 100 deg. C. lower.

Insulator Thermal Conduction

If the insulator is made of sintered alumina of high thermal conductivity, such as the Sintox used by Lodge Plugs, Ltd., the temperature of the nose of the insulator is normally slightly lower than that of the projecting central electrode. On the other hand, deposits on the insulator surface having poor thermal conductivity may become incandescent and cause pre-ignition when the temperature of the central electrode is appreciably lower.

In selecting the correct type of plug for any particular engine, it is important to ensure that under the severest conditions the electrodes will not become hot enough to cause pre-ignition or after-running. It is equally important that the plug should not run too cold and so be prone to fouling, due to the insulator not becoming hot enough to burn off deposits of carbon, etc. The Lodge thermocouple plug enables this design and selection of plug to be made on the basis of accurate measurements carried out under actual service conditions. This is only one application of the thermocouple plug.

It must be remembered that a great deal of heat is developed in a sparking plug in the neighbourhood of the central electrode, and this heat must be led by conduction to the cylinder head and dissipated. The path by which the heat from the central electrode is mainly conducted away is shown in Fig. 1.

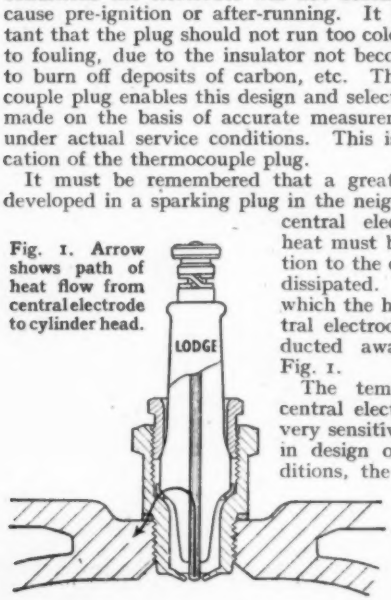


Fig. 1. Arrow shows path of heat flow from central electrode to cylinder head.

The temperature of the central electrode is therefore very sensitive to any changes in design or operating conditions, the effects of which can be measured with an accuracy of ±2 deg. C. by means of a Lodge thermocouple plug.

As an example, the effect of different running conditions on the plug temperature in a well-known 11 h.p. car is shown by the data given below:—

TABLE 1.

Running Conditions.	*Speed.*	*Electrode Temp. °C.*
Steady on level	30 m.p.h.	545
,,	40 ,,	600
,,	50 ,,	667
,,	60 ,,	735
,,	70 ,,	775
Max. revs. in 3rd	——	745

In another test, temperatures were recorded in the various cylinders of a 6-cylinder engine at different speeds on the road. As will be seen from the measurements, recorded in Table 2, No. 1 cylinder was running considerably hotter than the others, indicating to the designer that some modification in cooling or distribution was necessary.

TABLE 2.

	Temperature °C.		
Speed.	*No. 1 Cyl.*	*No. 3 Cyl.*	*No. 6 Cyl.*
30 m.p.h.	520	480	480
40 ,,	580	500	500
50 ,,	690	580	580
60 ,,	850	700	700

The construction of the standard type of motor car thermocouple plug is illustrated in Fig. 2. The thermocouple is located $\frac{3}{32}$in. from the end of the central electrode, and, being only 10 thousandths of an inch in diameter, does not affect the characteristics of the plug. The plug is provided with three terminals, as shown in the illustration, marked H.T., + and −, the two latter being connected, by means of a special compensating lead, to the millivoltmeter. This instrument should be of the high-resistance type with a full-scale reading of about 12 millivolts. Calibration curve and full instructions are provided with the plugs. Being of robust construction, thermocouple plugs give a service life comparable with that of standard plugs.

These plugs can be used either for bench tests or in vehicles under service conditions on the road. In the latter case the millivoltmeter is placed in the vehicle in any convenient position for the observer to record the temperature under various speed and load conditions. The general arrangement is shown diagrammatically in Fig. 3.

The aero type of thermocouple plugs is of somewhat different design, as shown in Fig. 4. The central electrode is made of fine platinum alloy wire which passes through a hole in the nose of the insulator, communicating with the bore in which a core of silver is cast. A gas-tight seal is formed above the silver core by means of a special glass seal. The platinum electrode is too small to carry the thermocouple, which is

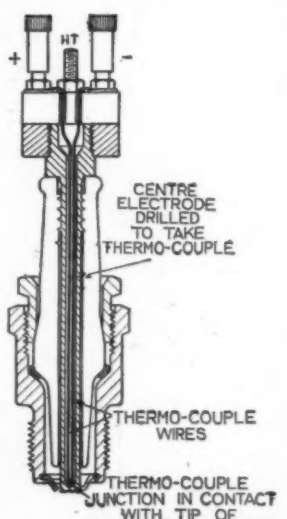


Fig. 2. Thermocouple plug. Motor car type.

THERMOCOUPLE PLUGS

therefore located just inside the nose of the insulator, being embedded in the silver core but insulated therefrom electrically. The temperature at this point is, of course, somewhat lower than at the tip of the central electrode, but is equally valuable for determining the effect of changes in design and operation. At pre-ignition, when the platinum point is at 1,120 deg. C., the silver core reaches a temperature of 850 deg.-900 deg. C., a difference of 250 deg. C. By locating thermocouples at other points in the silver core, the temperature distribution along the plug has been determined.

Some typical measurements made by Messrs. Rolls-Royce, Ltd., on Merlin single-cylinder units with a Lodge RS5/4 type thermocouple plug are recorded in Fig. 5. The straight line relation between the B.M.E.P. and temperature shown in the lower graph is characteristic of results obtained with all types of engine over the working range.

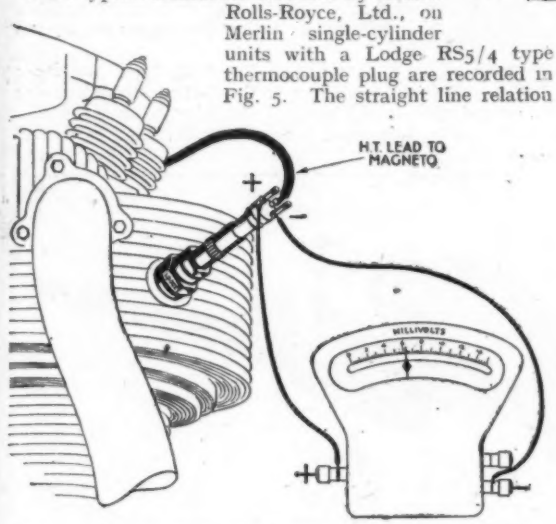
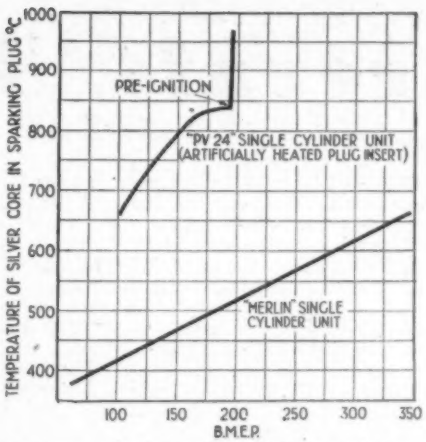


Fig. 3. Arrangement of thermocouple plug and millivoltmeter.



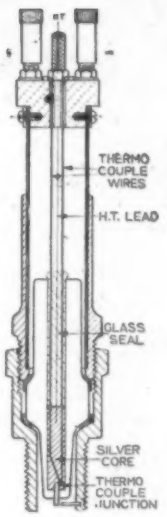


Fig. 4. (Above) Thermocouple plug. Aero type. Fig. 5. (Left) Typical measurements made on Merlin single-cylinder units.

The upper curve obtained in a single-cylinder unit designed to determine the pre-ignition rating is also characteristic. Shortly before the pre-ignition point is reached, the rate of rise of temperature decreases, due to auto-ignition taking place, and this is followed by a sudden marked increase in temperature at the pre-ignition point. The thermocouple plug, therefore, provides a very convenient means of determining the pre-ignition point, and for comparing the rating of different types of plug.

The use of thermocouple plugs is proving of great assistance in the development of suitable plugs for new or improved types of aircraft engine. The optimum temperature for the silver core under maximum load conditions in the engine has now been established by experience, and this provides a rapid method of determining the correct heat factor when a new type of plug has to be produced.

TRUMAN REPORT BOMBSHELL

ALLEGATIONS made against the Wright Aeronautical Corporation, a subsidiary of the Curtiss-Wright Corporation, in the report of the Truman Investigating Committee have shocked the world of aviation on both sides of the Atlantic. The charges made, and vigorously denied by Wright officials, accuse the Corporation of supplying defective aircraft engines with the connivance of Army Air Force inspectors, and it has been announced by the Department of Justice that a Federal grand jury investigation would be undertaken if the preliminary enquiry warranted criminal prosecution.

In the meantime, the U.S. Government has filed civil suits for damages against the corporation at Trenton, New Jersey, and at Lockland, Cincinnati. Acting on information from the Truman sub-committee of Congress, which is engaged on a continuous study of the U.S. war effort, the Government began proceedings at Trenton on a charge of selling to them aircraft engine materials which were "defective, sub-standard and unsatisfactory," and at Lockland they have filed a suit for "entering into a conspiracy to defraud the Government by knowingly presenting false, fictitious and fraudulent claims to the authorities."

Mr. G. W. Vaughan, president of the Curtiss-Wright Corporation, has declared that the Government's charges are "false and unwarranted," and Mr. Myron B. Gordon declared that the company was prepared to fight to a finish the charges made against it of selling defective aircraft engines to the Government.

On the position at Willow Run, the Truman report says that in spite of the warnings of many experienced aircraft engineers, the production line was set up similar to that of an automobile assembly line, with the result that they were very slow in getting into production, and that until recently the Ford Motor Co. had not produced at Willow Run an aircraft that was capable of use at the front. The committee had been informed, however, that great progress had since been made and the Willow Run plant was now producing Liberators in substantial numbers.

BY B.O.A. TO MOSCOW

BRITISH OVERSEA AIRWAYS CORPORATION'S new service to Moscow, recently announced, is the first through service from this country to the Russian capital and, though the wartime route is necessarily circuitous, its flying time of 3½ days allows a 24-hour break at Cairo.

The service, which naturally carries only official passengers, mail and urgent freight, is not on a fixed schedule, but present requirements make it fairly frequent in both directions, the route being via North Africa, Cairo, Habbaniyah (Iraq), Pahlevi (Persia), Astrakhan and Kuibishev.

A well-known type of four-engined landplane is used, but we are not allowed to divulge its name at present.

Gas Turbines and Jet Propulsion for Aircraft
By G. GEOFFREY SMITH, M.B.E.
A second edition of the above booklet is now available from "Flight" publishing offices. The new work consists of ten chapters and includes many illustrations. Price 3/6 plus 3d. post.

Fifty-eighth of the Latest Recognition Series

Aircraft Types and

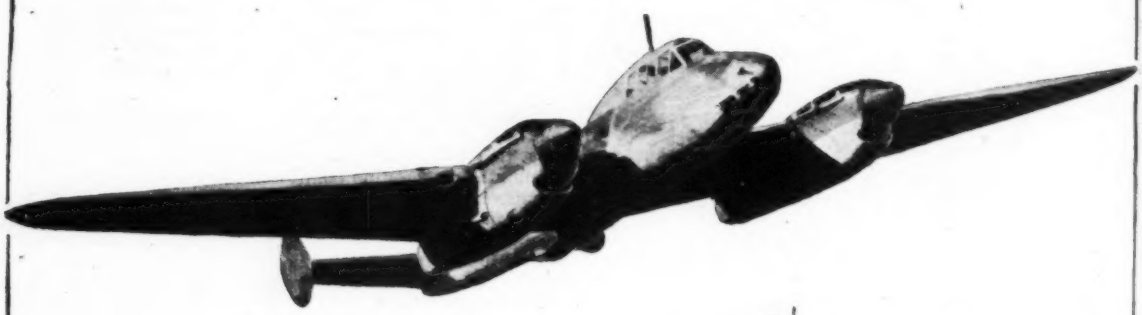
PE-2

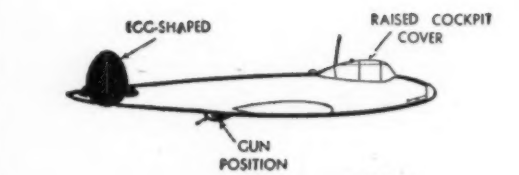
NOW one of the most widely used types in the Russian Air Force, and probably also the most efficient, the PE-2 is a light reconnaissance bomber which carries a crew of three or four according to the duties upon which it is engaged. It has come into service since the beginning of last year and has to some extent replaced the rather slower SB-3 bomber.

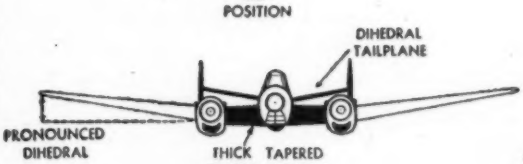
Powered by a pair of M-105 liquid-cooled, V type in-line engines, each with a maximum output of 1,100 h.p., the PE-2 has a top speed of about 300 m.p.h. and carries an internally stowed bomb-load of 1,700 lb., so it is a very useful aircraft indeed. Its defensive armament consists of a pair of machine guns mounted in the nose, and others mounted at the rear of the cockpit enclosure and in a ventral position aft of the bomb bay. In the case of the nose guns, these are generally flexible, like the others, but it is believed that certain versions of the PE-2 have them fixed. In the former case their arc of fire would be somewhat restricted owing to the shape of the nose and the cramped position of the bomb-aimer/navigator who has to use them.

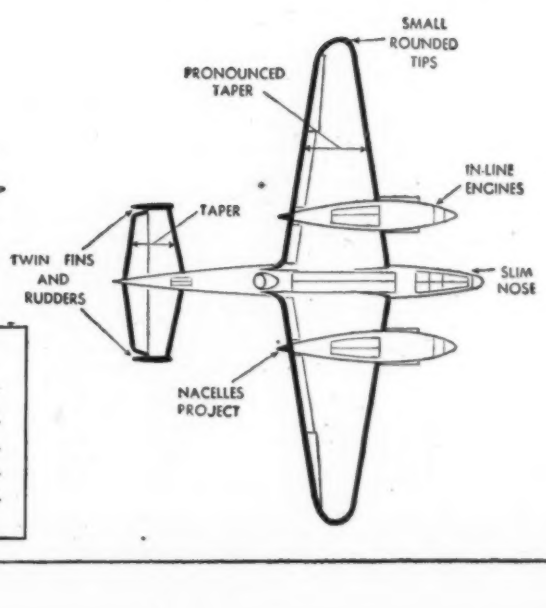
Students of recognition should remember that the PE-2 bears a strong superficial resemblance to the P-2, or YAK-4, as both these twin-engined low-wing bombers have the "snake's head" type of fuselage and egg-shaped twin fins and rudders mounted as vertical endplates on a tapered tailplane with dihedral angle. The PE-2, however, is a much larger aircraft, has a longer nose and a more streamlined cockpit enclosure. It is of all-metal construction with flush-riveted light alloy stressed-skin covering to wings and fuselage, except for fabric-covered control surfaces. Split trailing-edge flaps are fitted between the ailerons and engine nacelles.

But for the fact that it is a low-wing type, the PE-2 would bear a fair resemblance to the British Mosquito from any frontal view which masked its twin fins and rudders. It is, however, somewhat larger than the famous British light bomber.







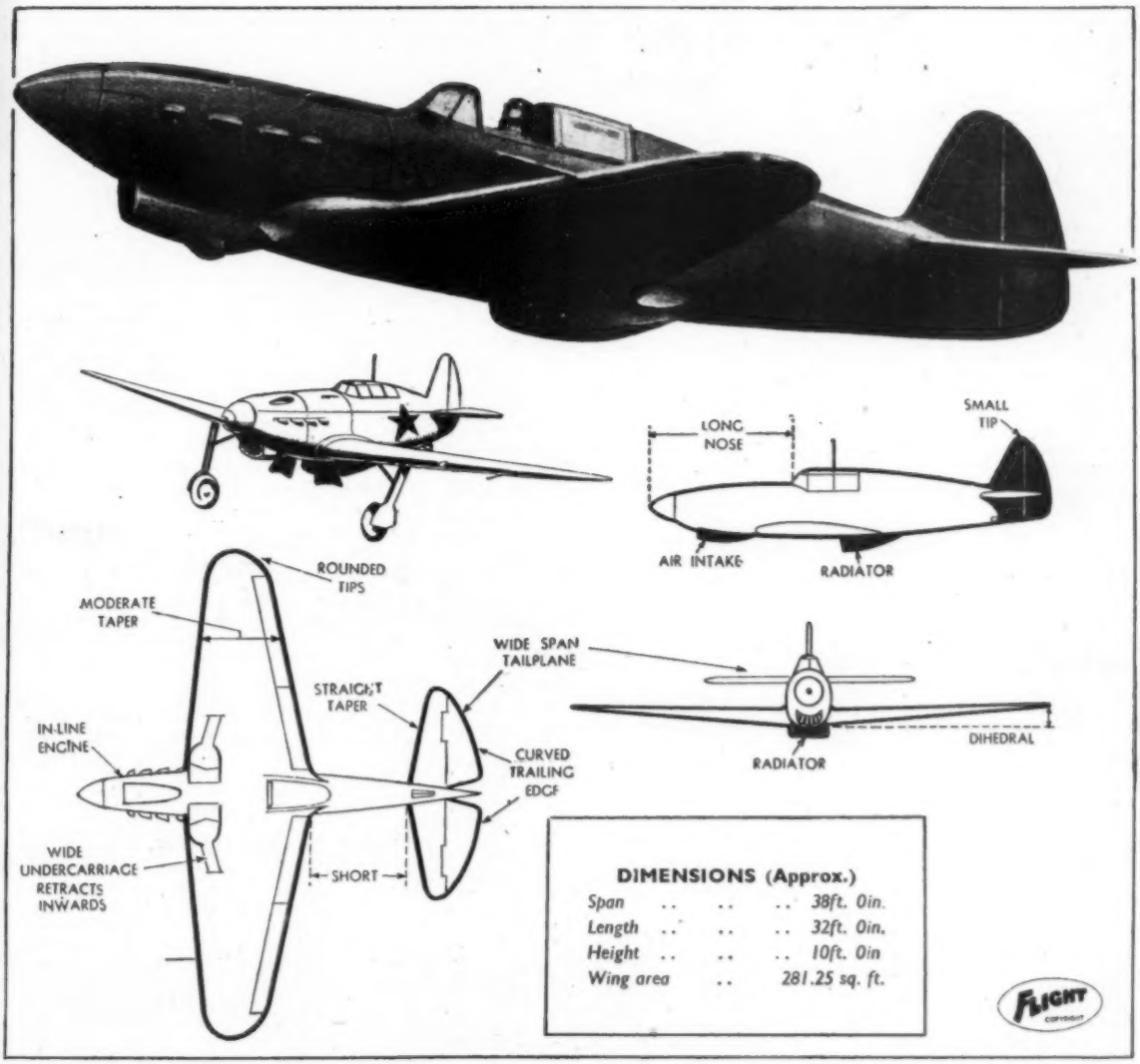


DIMENSIONS (Approx.)

Span	*60ft. 0in.*
Length	*45ft. 6in.*
Height	*13ft. 0in.*
Wing area	*592 sq. ft.*

...heir Characteristics

I-26 (YAK-1)



DIMENSIONS (Approx.)

Span	*38ft. 0in.*
Length	*32ft. 0in.*
Height	*10ft. 0in*
Wing area ..	*281.25 sq. ft.*

WHEN the Russian fighter squadrons underwent extensive re-equipment in the autumn of 1941, the I-26 (or YAK-1) was one of the then new types which replaced the radial-engined I-16 Rata and even, in some cases, the much older biplane I-15 Chato. It has since been built in quantities in several State factories and is in service on all sectors of the Russian front, along with the I-61, or MIG-3, popularly known as the Russian Spitfire and the Soviet's fastest fighter.

One 1,200-h.p. AM-35A 12-cylinder, liquid-cooled, in-line V-type engine with two-speed supercharger gives the I-26 a top speed of 360 m.p.h., and although its armament is limited to a pair of synchronised machine guns mounted in the nose above the engine and firing from troughs, and a single cannon mounted between the cylinder blocks and firing through a hollow airscrew hub, it at least equals the fire-power of the Messerschmitt Me 109F which it mainly encounters. Its cannon, incidentally, is credited with the high rate of fire of 1,000 rounds per minute or thereabouts. Another version, however, is reported to have eight machine guns in the wings.

All-metal construction is employed, the fuselage being of monocoque design, and a light alloy stressed-skin covering is used for all except the control surfaces, which are fabric-covered. The split trailing-edge flaps, however, are metal covered. The undercarriage retracts inwards and the tailwheel is also fully retractable.

In general appearance the I-26 somewhat resembles the Tomahawk, especially about the nose and tail unit. But its wing plan lacks the straight leading-edge of the Curtiss design, the fuselage has a longer and flatter line and the "wing nut" tailplane of the Russian fighter is of appreciably higher aspect-ratio. It also has a useful recognition feature in the presence of large scoops under both nose and fuselage.

Incidentally, it may be of interest to explain that "YAK" is an abbreviation for Alexander Yakovlev, one of Russia's leading aircraft designers at the present time.

Behind the Lines

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Nervous

THE Hungarian Government issued new regulations governing the arrangement of air-raid precautions, and has decided to form an A.R.P. Corps for which men and women are shortly to be recruited.

Aces

AS the most successful night fighter pilots of the *Luftwaffe* the German Press mentions the names of Lt. Gen. Kammhuber, commander of a night fighter formation; *Oberleutnant* zur Lippe-Weissenfeld and N.C.O. Gildner.

Conscripted

SEVERAL workers at the German-controlled Kjeller aircraft factory near Lillestroem in Norway have been ordered to go to Finland for service as mechanics with the *Luftwaffe* at Petsamo. While the result of protests lodged by the workers is not known, it transpires that up to the end of June, ten workers received similar orders, and it is quite likely that similar conscription will be enforced in other aircraft factories outside Germany.

New Material

DESCRIBED in the German Press as "unique in Germany, and also in the whole world" is a new material produced by a firm in Würtemberg and tested by Reich's Material Testing Institute at Stuttgart.

The material, known as *Pressband*, is a type of processed wood, and is composed of thin birch veneers compressed with elastic sheets of vulcanic fibre, and bonded together with a dry synthetic adhesive. The material is elastic, temperature resistant, and stronger and lighter than metal. An experiment with a door handle made of *Pressband* has shown that it successfully resisted a tensile strength test of 11,000 lb. without change.

Since it can be formed into all sorts of shapes during the process, it is said that there is hardly a limit to its application. According to the German report the material will be used in the aircraft industry, and because of its economy in the use of timber, also for pre-fabricated structure parts of buildings.

Gliding in France

THE official report on gliding activities in France during 1942 states that the total number of flying hours amounted to 4,508 and that the number of licences issued increased over that in 1941. During the period under review 466 "B" licences, 218 "C" and 15 for the "D" class are said to have been issued.

New Men for A.R.P.—

THE Italian A.R.P. organisation, U.N.P.A. (*Unione Nazionale Protezione Antiaerea*) is still on the look-out for the best man to run it. The intensification of Allied air attacks against Italy resulted in a periodical reshuffling of the high posts of the organisation, and the process still continues.

After the heavy raids on Northern Italy the Chief of the U.N.P.A., Giuseppe Stellingwerff, was replaced by General Luigi Gambelli. A recent report states that General Gambelli has now been replaced by General Enrico Armando.

—And for Federations

A DECREE of the Italian Government introduces several changes in the professional associations connected with aeronautics. Prof. Giovanni Balella has been appointed President of the Fascist Chamber of Industry, which controls the Aircraft Industry Federation, the *Gruppo Costruttoni Aëronautici Italiani*. Councillor Luciano Gottardi takes over the chairmanship of the Fascist Federation of Industrial Labour, which includes the Society of Airmen (*Gente dell'Aria*) and the Union of Aircraft Workers.

Rumour

WHILE German authorities deny the the report that Rommel was travelling in the heavily escorted aircraft which was shot down in the Mediterranean, it has since been suggested that the passenger was Field Marshal Kesselring of the *Luftwaffe*, who was some time ago entrusted with the organisation of the defence of Sicily, and who showed the Italian King around on the occasion of the latter's recent, and perhaps last, visit to the island.

Booty

AS previously reported, shortly after the occupation of Vichy France the Germans ordered the dissolution of the Vichy Air Force. It has recently become known that they have also confiscated the entire flying equipment and spare parts stocks. The booty consisted mainly of Bloch 151 and Bloch 155 single-seater fighters, Lioré and Olivier Lé 045 twin-engined bombers, and Potez 63 twin-engined general purpose aircraft. Not satisfied with this loot, the Germans have ordered the Vichy Administration to overhaul a number of obsolete Bloch 200 and 210 twin-engined bombers before they take them over.

Concentration

TOGETHER with the reorganisation of the French aircraft industry, which is now entirely controlled by the Germans, measures are being taken to co-ordinate French light metal production. It appears that most of the aluminium-producing firms are to be concentrated under the patronage of the *Compagnie Générale du Duraluminium et du Cuivre*, a company which has been recently created with a capital of 200,000,000 francs. Since June 1st, plants of the *Compagnie Générale d'Electro-Metallurgie* and the *Aluminium Français* in Chambréy, have beep taken over, and while the former produces duralumin, the latter plant is to be engaged in the manufacture of different light metal products.

Honourable Tools

AXIS broadcasts report that an exhibition of the Japanese machine tool industry is taking place in Tokyo to demonstrate to the people the results of the first measures taken for the simplification of types necessary by war conditions. Only relatively simple machines, such as lathes, are being shown and a report says that work on precision tools is still in development.

Incidentally, the Japanese machine tool industry, which started some 15 years ago, went through a boom period after the "China Incident" when many small enterprises sprang up. By 1938 the Government intervened in an attempt to reorganise the industry to improve quality and production methods. As a result of this concentration the number of plants has decreased from 1,000 to the 400 existing in 1940, but standards of production still lag behind those of Europe and America.

It is for this reason that the machine tool industry was the first to be taken under Government patronage soon after Pearl Harbour.

Incidentally, it is worth noting that the majority of machine tools at present built in Japan are said to be copies of American types, as prior to the war the Japs were buying extensively on the American market.

CORSICAN SIESTA: *Regia's* units take shelter in the seaplane base. Picture shows a Cant. 501, powered with one Isotta-Fraschini "Asso" XIR C.15 V-type 12-cyl. water-cooled engine of 840 h.p., which gives the aircraft a max. speed of 171 m.p.h. The aircraft is armed with four M.G.s.

Plywood and Plastics-I

Resin-bonded and Impregnated Wood Veneer Heralds a Return to Wood Construction

By W. NICHOLS, A.R.Ae.S.

THE extensive use of plywood in aircraft construction during the first world war was quite general in spite of disadvantages then inherent in the material available. Later, the discarding of wood as a structural material by the industry was hastened, due to the fact that glues available at that time, mainly of animal or vegetable origin, were not durable over a period of time, and, moreover, encouraged parasitic growth, the detection of which was difficult, since nearly all glued joints affected were hidden within the structure.

Now, with the evolution of a new technique, the pendulum is again swinging back in favour of wood construction, the reason being two-fold. First, the development during recent years of synthetic resins as adhesives and for the impregnation of wood veneer has resulted in plywood and manufactured compressed woods of vastly superior properties than hitherto. Secondly, the desirability to conserve, so far as possible, metallic materials in the prosecution of the second world war has made it advisable for the aircraft designer to once again think in terms of wood wherever it can be usefully employed.

The trend towards plywood construction is gaining some momentum in this country and the U.S.A., and there now appears vital need for fundamental design data to be disseminated. Design principles applying to metal stressed-skin structures do not fit in with wood construction. In order to obtain the maximum usefulness of plywood as an aircraft material, it is essential to design specifically to plywood characteristics at its present stage of development and workability. Therefore, full consideration must be given to these factors and new principles adopted.

The British aircraft industry has indeed made a "flying" start in the design and production of a modern first-line aircraft in wood by an outstanding achievement and masterpiece in the form of the Mosquito, designed and built by the De Havilland Aircraft Co. A full, illustrated description of this aircraft appeared in *Flight* of May 6th, 1943.

This versatile aircraft (day bomber, night bomber, and intruder) is a descendant of a long line of successful aircraft of wood construction, and has proved in no uncertain manner, and to our enemies in particular, that operational aircraft of very superior qualities constructed of wood are once again of paramount importance in the successful prosecution of the war.

There are several advantages to be gained from wood construction wherever it becomes feasible to adopt it (for it still, of course, has limitations). These advantages are especially important in wartime. Among them may be mentioned the possibility of constructing a prototype with considerable reduction in cost and in a shorter period; also the repair and maintenance of the primary structure in the Service is greatly facilitated. From the production point of view a vast body of woodworkers from other industries are available as skilled and semi-skilled personnel, and likewise the numerous factories equipped for woodwork in various fields of industry can conveniently switch over to the production of complete assemblies or component parts. This has been amply demonstrated by the production of the Mosquito in this country and within the Empire.

Origin of Synthetics Used

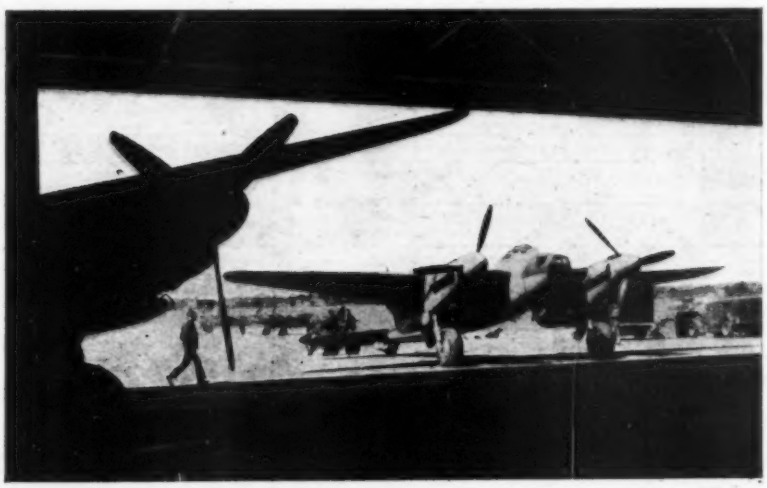
The prime factor simplifying the modern construction of aircraft and component parts in wood is the versatility of the synthetic resins used. Fully to appreciate the modern technique it is necessary to have some knowledge of the resins commonly used. It is proposed, therefore, to begin this article with such a review.

The probability now exists of the whole field of synthetic materials being dominated and expanded still further by "plastics" made from wood. More than any other raw material, wood disregards the boundaries separating substances by their functions, being chiefly composed of cellulose and lignin (about 25 per cent.) and is the prime source of both.

From a geological point of view wood is also the origin of other synthetics, for the process involved in the conversion of wood into coal results in the conversion of the lignin into the bituminous mass coal. When bituminous coal is distilled, among the chief products obtained are coal-gas and coal-tar. From the latter, when submitted to fractional distillation, are collected, among others, carbolic oil and creosote oil. These oils are for all practical purposes the only source of phenols for synthetic resins used in this country and of the group widely used for bonding and impregnation of aircraft materials. Phenol, the chemical formula of which is C_6H_5OH, is obtained in the form of large colourless crystals which melt when absolutely pure at 42.5 deg. C. and boil at 181.7 deg. C. The grade used in synthetic resin work has a melting range of 41.5 deg. C., the lower melting point being due to the presence of a trace of creosols.

Synthetic resins fall under two distinct groups, thermo-setting and thermo-plastic, the former being widely used in the fabrication of flat panels.

The use of both such adhesives involves the action of high temperatures



An outstanding example of modern British design, the De Havilland Mosquito constructed of wood—mainly plywood.

PLYWOOD AND PLASTICS

and relatively high pressures, the resulting bond being stable and permanent. Heat and pressure required with the thermo-plastic resins, however, are not of the same magnitude. Thermo-setting resins experience a chemical change under heat in which water is given off. It may be compared for analogy to cement, inasmuch as once it has set by the condensation of this water, it can never be made to liquefy or flux again. Thermo-plastic resins do not experience any chemical change, and a plywood panel fabricated in its flat form can later be treated by a source of heat and bent to a desired shape over a form or mould, and when reset will retain its new shape.

Phenol-formaldehyde and urea-formaldehyde resins are of the thermo-setting variety. Thermo-plastic materials may be formed and then reformed many times into definite shapes by the simultaneous application of heat and pressure, providing sufficient plasticising materials be incorporated to impart the proper flow, and the material remains plastic so long as the requisite temperature is maintained. Vinylite resins belong to this class, and have been

TABLE I.—PLYWOOD ADHESIVES AND CHARACTERISTICS

1	2	3	4	5	6	7	8
Adhesive	**Blood Albumen**	**Animal**	**Vegetable Starch**	**Casein**	**Urea-Formaldehyde Resins**	**Phenol-Formaldehyde Resins**	**Thermoplastic Resins**
Source	Dried beef blood.	Hides and bones of animals cooked in water, evaporated, jellied, dried.	Vegetable carbohydrate. Base mainly cassava (tapioca) also potato flour.	Precipitated from milk.	Urea—CH_2O condensation.	Phenol—CH_2O condensation.	Chiefly plasticised polyvinyl butyraldehyde.
Form supplied ...	Powder, flake.	Powder, pearl flake, shreds.	Flour.	Powder.	Powder and liquid.	Lumps, powder, liquid and film.	Resin solution in organic solvent.
Cold or hot press...	Hot press.	Cold.	Cold.	Mainly cold, some hot.	Mainly hot, some cold.	Mainly hot, some cold.	Hot press.
Added ingredients of mix.	Water, alkalis, paraformaldehyde, hydrated lime, albuminous adhesives, etc.	Water, some preservatives.	Water, and alkalis (sodium hydroxide).	Water, CH_2O, preservatives, and alkalis (lime and sodium salt).	Water accelerators, wheat and rye flours.	Alcohol and water, flour fillers.	None, thin with solvent if necessary.
Preparations for use	Mixed cold.	Soaked in cold or warm water followed by cooking.	Generally mixed hot.	Mixed cold.	Some mixed with water only; others accelerator and flour added.	Dry film — nil. Liquid resin—nil. Solid resin dissolved in alcohol and water. Catalyst added for cold pressing, warm setting and fast hot pressing.	None.
Life of mixture ...	2 hours to several days.	Extended if preserved.	Many days.	2 hours to 2 days (preferably short).	Up to 1 day.	Extended period for hot press material. Several hours for cold press resin.	Indefinite. Not reactive.
Spreading and handling equipment.	Roller spreader.	Heater, roller spreader.	Roller spreader.	Roller spreader.	Roller spreader.	Liquids in roller spreader film used as film.	Roller spreader.
Spread, pounds per 1,000 sq. ft.—dry basis.	10–35.	25–35.	20–30.	12–35.	16–25.	25–40 for cold press resin. 10–14 for hot press liquid. 11–12 for film.	6–14.
Pressing temp. ...	180–250° F.	Cold, with warm cauls.	Ordinary room temp.	Ordinary room temp. for cold press, 180–250° F. hot press.	210–240° F.	Room temp. to 326° F.	230–300° F.
Pressing time ...	3 min. for hot press; varies with thickness of panel. Overnight cold press.	2–18 hours.	4–18 hours.	2–18 hours for cold press. 3 min. for thin panels hot press.	3 min. for thin panels hot press. 8 hours for cold press.	3–6 min. for thin panels hot press. Overnight for cold press.	Few minutes to several hours—must be cooled in press or mould.
Moisture content allowed in veneers.	2–3% for faces, 5% or less for cores and crossbands.	As Col. 2.	As Col. 2.	As Col. 2.	Wide range—2 to 100% under special conditions.	2–14% for liquid resin. For film, cores and crossbands 5–10%, faces 2–6%.	3–12%.
Dry bond strength.	Medium.	Very high.	Medium.	Medium.	High.	Medium to high.	Low to medium.
Wet bond strength.	Medium.	None.	None.	Poor to medium.	Medium to high.	Excellent in both hot and cold water.	Medium.
Water resistance ...	Medium.	Poor.	Poor.	Poor to good.	Cold water : good. Hot water : poor.	Excellent.	Medium.
Mould resistance ...	Poor to good.	Poor.	Poor.	Generally poor.	High.	Excellent.	High—not affected.
Heat and fire resistance.	Poor.	Poor.	Poor.	Poor.	Moderate.	High.	Poor.
Moisture transmission.	Marked.	Marked.	Marked.	Marked.	Medium.	Low.	Low.
Exterior durability.	Fair to good.	None.	None.	Poor.	Good.	Excellent.	Poor to good.
Relative cost ...	Medium to high.	High.	Very low.	As Col. 2.	Resin alone high, with fillers low.	High.	High.
Special features ...	Especially suitable for low temp. Hot pressing, most durable of adhesives except resins.	Relatively expensive. Easy to use.	Inexpensive adhesive.	Superior to vegetable glue for wet strength.	Very economical when mixed with flour. Provides a highly water resistant bond set hot or cold.	By far the most durable bond : resists all forms of deterioration.	Flows at elevated temp., must be cooled in press. Will reseal. Plies retain flexibility.

PLYWOOD AND PLASTICS

used with the American "Vidal" process for moulded plywood structures, to be dealt with later.

Purpose of Formaldehyde

The source of phenol having been described, it should be stated that formaldehyde is a gas CH_2O, the product of wood distillation, also obtained from coke oven or producer gas. It liquifies at −21 deg. C. and solidifies at −2 deg. C. It is prepared by the catalytic oxidation of methanol (synthetic methyl alcohol) at about 450 deg. By this means formaldehyde is obtained as a solution in water and methyl alcohol containing about 40 per cent. CH_2O by volume or 37 per cent. by weight is known as "Formalin." Formaldehyde is unique inasmuch as it is the only aldehyde to give rapidly thermo-setting resins with phenol and urea. The original phenol-formaldehyde resins were produced by Baekeland, a U.S. citizen of Belgian origin, in the manufacture of his "Bakelite" materials and are still frequently referred to by this term.

"Urea" is the result of heating carbon dioxide and ammonia while at high pressure, whilst Vinyl is derived from acetylene.

Casein has been used extensively in the past as a plywood adhesive, and is a product of skimmed milk. It can be toughened and rendered proof against decomposition by soaking in a formaldehyde solution.

TABLE 2.—PRESSURES FOR USE WITH TEGO FILM ADHESIVE

Wood	Pressure, lbs./sq. in.
Pine, Douglas Fir, and Spruce	120/140
Poplar, Basswood	140/150
High-density Woods	150/200
Thin stock of Hardwoods, such as Birch, Maple, Beech	200/300

Briefly the above resinoids are those mainly used either in bonding or impregnating aircraft plywoods, and of these the phenolic resins made from carbolic acid or cresylic acid (cresol) together with formaldehyde and the urea formaldehyde resins are the most common. Characteristics for a group of adhesives are incorporated in Table I, from which is apparent the superiority of the synthetic over those used in the past, included for comparison.

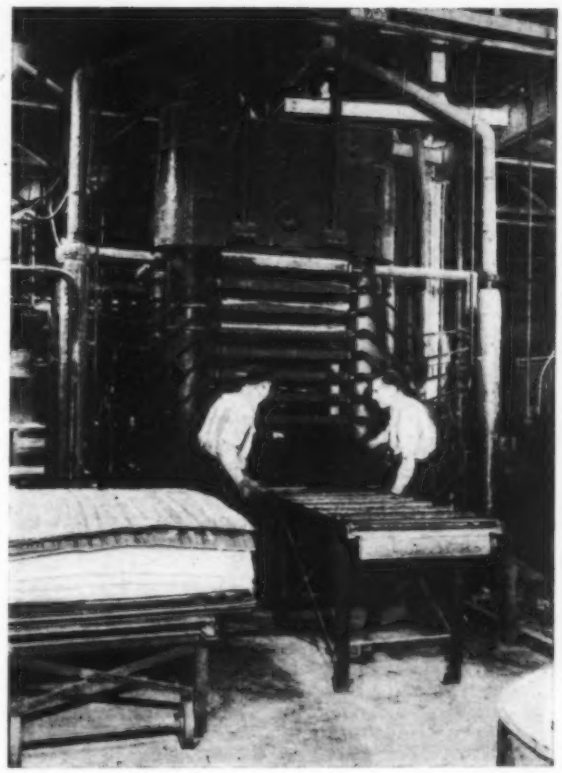
A more detailed examination of the various types under their trade name becomes necessary. Phenol-formaldehyde adhesives are supplied in two forms, as dry film and liquid glues. Of the dry film type, an example is the well-known Tego film made by British Tego Gluefilm, Ltd., a subsidiary of the Micanite and Insulators, Ltd. The successful application of this adhesive is dependent upon the moisture content of veneers—8 to 12 per cent., and a temperature range of 280-300 deg. F. is recommended, the higher value being preferable as it reduces the time necessary to effect a full cure. In the bonding operation a stack of veneers interleaved with gluefilm should be placed in the press with a thin aluminium sheet at the top and bottom of the press. Bonding processes are given in Table 2, with other characteristics shown in Fig. 1.

In general, the pressure should be kept as high as possible without danger of crushing the veneers, since the shear value of the joint increases with bonding pressure. On the other hand too high a pressure may cause warping in the panel. The time which the stack remains in the press is dependent upon the thickness and may run from five to twenty minutes.

Another type of similar film adhesive is Plybond, manufactured by Bakelite, Ltd. In this case the recommended moisture content of the veneers is 7 to 10 per cent., which from a later description dealing with the subject it will be seen is general. Pressing temperature should be controlled between 140-150 deg. C., and pressure between 250-300 lb./sq. in.

Time in the press is again dependent upon thickness of board being produced, and may be taken to be 3 minutes plus 1½ minutes for each millimetre thickness of the board. During the pressing operation moisture is forced out from the veneers, and in order to ensure the necessary joint strength it is desirable to replace this moisture. This is usually done by treating the boards in an atmosphere of steam, or by immersing them in water and dry off under normal atmospheric conditions. The most important advantage claimed for dry gluefilm adhesives are cleanliness and economy in operation, and the convenience in handling and storage.

Of the liquid phenolic adhesives, Cellobond, manufactured by Cellomold, Ltd., and distributed by F. A. Hughes, Ltd., is supplied in two forms for cold and hot pressing conditions. For hot pressing, conditions such as in the manufacture of plywood Cellomold Adhesive-Rocket Resin 1840 is used. It is prepared by mixing 90 parts of this resin and 10 parts of Plasticiser R.M.9.. Immediately before use 8½ parts by weight of Hardener R.M.36 must be vigorously stirred into the previous mix. Life of the mixed adhesive ranges from half an hour at 80 deg. F. to two hours at 60 deg. F. Pressing should be carried



Laminated material being loaded into a multi-press.

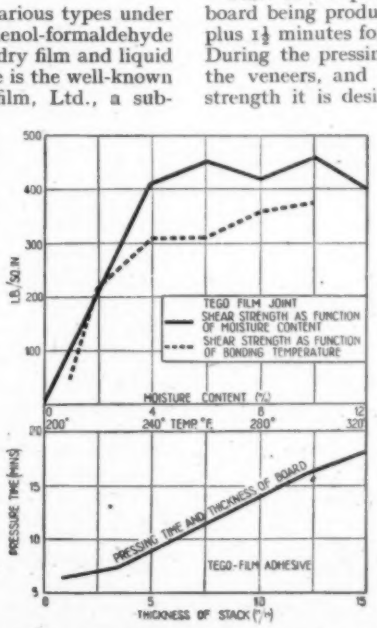


Fig. 1. "Tego" Gluefilm characteristics

PLYWOOD AND PLASTICS

put in presses with platens controlled at a temperature 194-212 deg. F. and pressure should be 100-150 lb. per sq. in. With this adhesive, 5 minutes plus 1 minute per millimetre of wood is recommended as the time required for pressing which should not be commenced until 30 minutes after the application of the adhesive. The urea-formaldehyde adhesives consist of two ingredients, the adhesive and the hardener—usually a weak acid which acts as a catalyst and promotes rapid hardening. In general, only one type of adhesive is marketed, but the use of hardeners to suit varying conditions are specified.

Widely used adhesives of this type are Aerolite and Beetle W and Beetle K for wide-gap joints, and a glue in powder form, Beetle H. Both hot and cold processes are available, and for the hot process two different hardeners are supplied, one for joints which have to be waterproof and the other for joints which must withstand the effect of boiling water.

Cold-press Process

Prior to application, the appropriate hardener is mixed with the adhesive and applied thinly to the wood, approximately 2½ lb. per 100 sq. ft. Wood surfaces should be roughened with sandpaper prior to application. Bonding is carried out in heated presses at a temperature of 90 to 100 deg. C. at a pressure of 28 lb. per sq. in. or more if necessary. With the hardener for waterproof joints the minimum time in the press is five minutes, whereas eight minutes are required for joints to withstand boiling water; one minute for each millimetre of wood being pressed should be added to the above times.

With the cold press, very strong joints can be made. The adhesive has a low water content which facilitates quick drying after pressing, and moisture content of the veneer is not so vitally important with these cements.

The procedure with the cold glue is to coat one side of the joint with the appropriate hardener using 1 lb. per 100 sq. ft., and allow to dry for a minimum period of thirty minutes. A very thin coating of glue is applied to the other joint face 2½ to 3 lb. per 100 sq. ft. After a period of about fifteen minutes the joint faces may be clamped together at room temperatures. Pressure is maintained over a period varying with the hardener used and ranging from two to twenty-four hours.

Beetle cements are manufactured by Beetle Products, Ltd., and temperatures, setting times and hardeners have been tabulated in Table 3.

TABLE 3

BEETLE W CEMENT COLD PROCESS: MINIMUM SETTING TIMES

Temp., Deg. F.	Setting Time with Hardeners		
	C.H. Orange	C.H. Yellow	C.H. White
50	45 mins.	5–6 hours	30–35 hours
60	30 mins.	3 hours	12 hours
70	20 mins.	1½ hours	4 hours

BEETLE A CEMENT SETTING TIMES, RAPID AND SLOW HARDENERS

Temp., Deg. F.	Setting Times with Hardeners	
	15 (Purple)	50 (Brown)
50	2 hours	—
60	1½ hours	20 hours
65	—	12 hours
70	1 hour	8 hours
80	½ hour	4 hours

BEETLE W CEMENT: HARDENER MIXTURES FOR HOT PRESS

Class	Proportions by Weight		
	Beetle W Cement	H.H. Liquid	H.H.12 (Powder)
Waterproof joints .	100	10	Nil
Joints to withstand boiling water ...	100	Nil	10

Aerolite cements are manufactured by Aero Research, Ltd., under the direction of Dr. N. A. de Bruyne, an authority on plywood and plastics. Further reference will be made to the work of this establishment.

TABLE 4.—AEROLITE ADHESIVES

SETTING TIME—COLD PROCESS

Hardener	Temperature, Degrees F.				
	50°	60°	70°	80°	90°
G.B.P.	5–6 hours	2½ hours	1½ hours	1¼ hours	1 hour
G.B.Q.	6–7 hours	3 hours	2 hours	1½ hours	1 hour
G.B.M.	10–12 hours	5 hours	3½ hours	2½ hours	2 hours

SETTING TIME: GAP FILLING GLUES AT HIGH TEMPERATURES

Hardener	Temperature, Degrees F.					
	104°	140°	158°	176°	194°	230°
G.B.P. ...	40 mins.	10 mins.	6 mins.	3 mins.	2 mins.	1¼ mins.
G.B.M. ...	60 mins.	15 mins.	8 mins.	4 mins.	2½ mins.	2 mins.

There are a variety of Aerolite adhesives, including Aerolite 300, 301 and 300 F, which differ mainly in their viscosity. Aerolite 300 F. is a stiff liquid designed to "stay put" in gaps where a glue of normal viscosity would run out from the joint. Aerolite 300 is less viscous than 300 F. and can be spread more easily. Aerolite 301 is a low-viscosity glue which is exceptionally easy to spread, but an essential point for its successful application is that it must only be used where time can be allowed for the glue to become really "tacky" before closing the joint. Hardeners for these adhesives are designated G.B.M., G.B.P. and G.B.Q., all approved for aircraft use. The method of use is somewhat similar to the previous cements described, and the period during which pressure should be applied, with the corresponding temperatures, are given in Table 4.

Digressing upon the characteristics of wood veneer and its various applications, the term "plywood," it would seem, may easily become misconstrued. Plywood properly describes the material of any wooden part built up of several thicknesses with the grain of the veneers running in different directions, and is generally used to convey the meaning of boards built up of three or more plies and

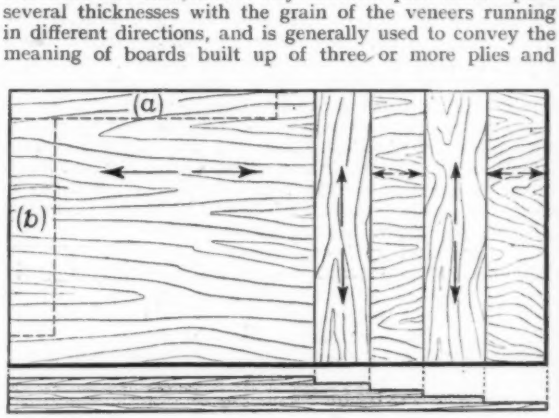


Fig. 2. Plywood specimen (a) grain of face-ply lengthwise (b) grain of face-ply crosswise. Arrows indicate direction of grain.

supplied ready for fabrication in the industry. Wood being stronger with the grain than across the grain, placing the grain of the alternate plies at right angles gives a better proportion of strength and stiffness in the two principal board directions, as shown in Fig. 2. For special purposes, the skin of a fuselage, for example, plywood is sometimes arranged with the grain of the plies at 45 deg. Though this is stronger, it is more expensive to produce.

(To be continued.)

In subsequent articles the production and characteristics of wood veneer are discussed, including moisture-content control and effect.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

ARRESTER GEAR

Can a Parachute be Used ?

IN *Flight* of March 18th, 1943, I was very glad to find some details about the experiments with the flying-pick-up of gliders by airborne aircraft. I was disappointed, however, that the tremendous possibilities of this method were not adequately stressed and its further development encouraged as strongly as possible, as some of the readers of *Flight* might be in executive positions where they could initiate further experiments and the practical application of their results.

There seem to be no reasons why the method of assisted take-off cannot be successfully applied to enable operational aircraft to take off from extremely restricted spaces or from normal runways in a hitherto far-too-overloaded condition. For this it seems far more promising than catapults or even winches.

The "converse" of the flying-pick-up method and apparatus, as I see it, is a device to enable aircraft of conventional design to reduce their landing run.

Equipment : A parachute (not like the anti-spin types, but conceived as of orthodox design and size, though perhaps very slightly stronger or larger) stowed in or near the tail and attached to a certain length of cable which is wound on a reel. The reel in turn is anchored to the strongest parts of the aircraft—which is usually the junction of fuselage to main wing spar.

The reel has an automatically increasing brake, which first allows the reel to unwind freely and then gradually begins to brake till it finally brings it to a stop altogether. (In fact, it is a reel of exactly the same design as used for a flying-pick-up.)

Operation : The parachute is released and the reel unwinds freely for the length of time necessary for the parachute to open fully; then the brake gradually increases till it finally brings the parachute to a halt (relative to the A/c.). Thus there is no sudden deceleration or shock. The increasing brake applies (or transfers) the braking energy of the parachute gradually and evenly to the aircraft, which is brought to a standstill very quickly.

Method of Landing : Very low powered approach with flaps, similar to approach of aircraft with tricycle undercarriage; parachute released (about 3 sec. or opening of parachute) before crossing the boundary of the landing field.

The apparatus, the increasing brake and reel and parachute can all be very safely tested on the ground by using cars or lorries instead of aircraft.

I hope that *Flight* will in its forthcoming issues again discuss the development and give further news of progress of the flying-pick-up and its converses, such as outlined above.

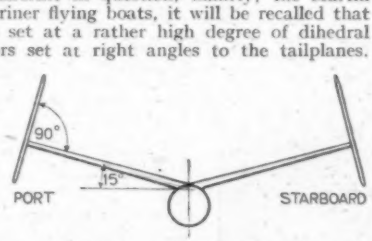
"SGT. R.A.F."

THEORY OF FLIGHT

Problem in Conflicting Functions

WISHING for enlightment on the subject of my enquiry below, I wonder if this may be published in *Flight* so that other correspondents may give their opinion on it?

Referring to the aircraft in question, namely, the Martin Mars and Martin Mariner flying boats, it will be recalled that they have tailplanes set at a rather high degree of dihedral with fins and rudders set at right angles to the tailplanes.



Assuming that each elevator has an angle of 15 degrees of dihedral from horizontal, it will be seen that by banking the aircraft 35 degrees to starboard this will bring the port elevator up to 50 degrees from horizontal, while the starboard one forms an angle of only 20 degrees below horizontal.

Now, when any aircraft is banked at any angle exceeding 45 degrees it will be noticed that the controls are reversed or, rather, "swopped" over, the "stick" controlling the elevators becoming the rudder control, and the rudder bar controlling the rudder becoming the elevators. It will here be seen that in putting rudder control on the Mars or Mariner during a 35 degrees or more bank the port rudder would act the part of an elevator as would the elevator "change over" to a rudder, while the starboard surfaces remained at their usual functions. Surely, this would affect the control of the aircraft during steep banks, due to the fact that half of the control planes would not function in their usual manner. Apart from perhaps increased structural strength, I can see no possible reason why the rudders should not be parallel to each other. The only thing I can think of, to explain how the rudders are controlled, is that they might be moved separately. Hoping someone will explain "the works" to a layman.

"PUZZLED AIR CADET."

TECHNICAL TRAINING

Existing Schemes Badly Need Revision

I HAVE read with very great interest the article in your issue of July 1st on the Education Board set up by de Havilland Aircraft, Ltd., and on other occasions articles on the education of future aircraft engineers, including one on the very excellent scheme run by the Bristol Aeroplane Co., Ltd., which was published some months ago. What a great pity it is that all aircraft firms do not have the foresight and appreciation of the needs of their future engineers as do these two companies.

Unfortunately, it is not the lot of every aspirant aircraft engineer or designer to receive a university training or to be a student at the de Havilland Aeronautical Technical School in order to fit him for his future career. What appears to be the most frequent course taken is to become an apprentice with a better-known firm of aircraft engineers and to avail oneself of part-time day classes at the local technical college (usually a course for the ordinary and higher national certificates in engineering). This scheme is not, in my opinion, out of date, as yet, but in a great number of cases is badly in need of drastic revision.

I can speak from experience in that I am apprenticed to a well-known Midlands firm of aircraft constructors. Undoubtedly the best part of my apprenticeship is the training which I receive at the technical college, but here is the first need for revision. I take the ordinary national certificate course in mechanical engineering; if I am successful in that I go on to the higher national certificate course. Here I ask what use the theory of steam engines of half a century ago and that of sound are going to be to me when, if I achieve my ambitions, I shall be designing reaction propelled spacecraft with speeds which would make that of sound appear trivial in comparison (I would remind readers that the time of such craft is very near). The essential need then for a specialised aircraft engineering course at technical colleges is obvious.

The second and by far the greater need for revision and reorganisation lies in the factory and office "training" which I receive. Here practically no attention is paid to the apprentice serving his time in the various departments. If he pays no attention to himself he will eventually rot away, and no one will bother about him; it does not concern them—its none of their business. If he gains some small amount of experience and knowledge it is entirely as a result of his own endeavours, and the scope for those endeavours, if the apprentice has any heart for them, is practically nil.

Admittedly there is a war in progress and war production must come first, but this does not by any means say that apprentices should be entirely neglected; there is such a time as after the war. In this post-war period the competition amongst aircraft firms to be in the fore of civil aviation will be extremely great. It will be the firms with the best technical experts and the most experienced engineers that will win; the best trained apprentices of to-day will be those best engineers and executives of to-morrow. This is what my and other aircraft companies fail to realise, and unless they rectify the position now, it will be too late.

Perhaps I have painted the picture black, but only because that is the correct shade; perhaps in some cases it is not black enough. I write this in the hope that it will help in some small way to make the change which is so badly needed.

"AIRCRAFT APPRENTICE."

SERVICE AVIATION

FRIEDRICHSHAFEN AND NORTH AFRICA : H for Harry, one of a force of Lancasters taking off for the raid on the Zeppelin works on the shores of Lake Constance. After leaving the target they landed in North Africa and bombed Spezia in Italy on the way home.

Royal Air Force and Fleet Air Arm News and Announcements

Promotion

GENERAL DUTIES BRANCH.

Air Commodore (temp.) T. M. WILLIAMS, O.B.E., M.C., D.F.C., is granted the rank of Air Commodore (war subs.). May 4th, 1943.

Awards

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards:—

For enterprise and skill in the destruction of a U-boat while serving in H.M.S. *Archer*:—

Distinguished Service Cross

Act. Temp. Sub. Lt. (A) W. W. N. BALKWILL, R.N.V.R.

Act. Temp. Sub. Lt. (A) H. HORROCKS, R.N.V.R.

Distinguished Service Medal

Ldg. Airman J. W. WICK.

Royal Air Force

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy.—

Distinguished Service Order

Group Capt. J. R. WHITLEY, A.F.C.—Group Capt. Whitley has been engaged in operational duties since the beginning of hostilities. He was posted to command his present station in May, 1941, and since then has displayed outstanding ability as a commanding officer. He has frequently taken part in operational flights and has attacked such heavily defended targets as Berlin, Bremen, Duisberg, Genoa and Frankfurt. Group Capt. Whitley has proved himself to be the ideal type of operational station commander.

Sqn. Ldr. C. F. GRAY, D.F.C., No. 81 Sqn.—Sqn. Ldr. Gray has taken part in many sorties in operations in North Africa and has destroyed five enemy aircraft, bringing his total victories to at least twenty-one.

Sqn. Ldr. R. B. THOMSON, A.A.F., No. 172 Sqn.—During recent anti-submarine operations this officer has achieved several successes. Towards the end of March, 1943, he successfully attacked a U-boat and three days later he accomplished a similar feat. On the latter occasion he pressed home his attack in the face of heavy opposing fire, straddling the U-boat with his depth charges. One night in April, 1943, Sqn. Ldr. Thomson successfully attacked an enemy submarine with depth charges and, some 20 minutes later, he attacked another one with machine-gun fire.

Second Bar to the Distinguished Flying Cross

Act Sqn. Ldr. J. J. LE ROUX, D.F.C., No. 111 Sqn.—Sqn. Ldr. Le Roux's magnificent leadership has played a large part in the many successes attained by his squadron. He has personally destroyed 14 enemy aircraft and damaged many others, and has also inflicted much damage on enemy shipping.

Act. Sqn. Ldr. J. E. WALKER, D.F.C., R.C.A.F., No. 243 Sqn.—Sqn. Ldr. Walker assumed command of this squadron at a difficult period. He has been largely instrumental for the many successes achieved by the squadron and has himself destroyed at least four enemy aircraft and damaged others.

Bar to Distinguished Flying Cross

Act. Sqn. Ldr. I. R. STEPHENS, D.F.C., R.A.F.V.R., No. 162 Sqn.—This officer has completed 72 operational missions. One night in March, 1943, his aircraft was subjected to a series of attacks by an enemy fighter. Although much damage was sustained and the rear gunner killed, Sqn. Ldr. Stephens resolutely held course until his purpose was accomplished. Displaying great skill, he flew the damaged aircraft safely to base.

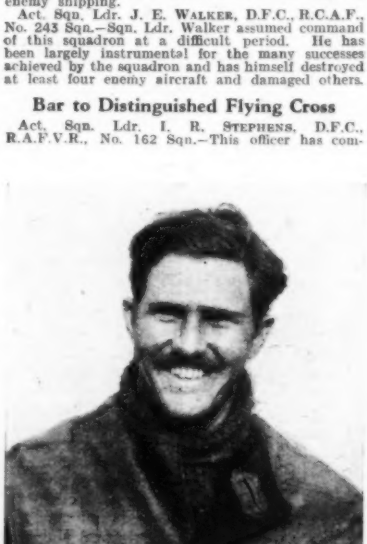
F/O. N. E. REEVES, D.F.C., R.A.F.V.R., No. 89 Sqn.—F/O. Reeves has destroyed nine enemy aircraft at night. In operations in the Middle East he has displayed exceptional keenness and great powers of endurance.

W/O. A. A. O'LEARY, D.F.C., D.F.M., No. 89 Sqn.—W/O O'Leary is an observer of exceptional merit. He has invariably displayed great courage and keenness and has taken part in the destruction of 14 enemy aircraft at night.

Act. Sqn. Ldr. J. J. LYNCH, D.F.C., No. 249 Sqn.—Sqn. Ldr. Lynch has taken part in many sorties and has led his formations with great determination. He has destroyed twelve enemy aircraft.

Sqn. Ldr. K. H. BURNS, D.F.C., No. 97 Sqn.—One night in May, 1943, this officer captained an aircraft detailed to attack Dortmund. Although on the outward flight one engine in the aircraft became unserviceable, Sqn. Ldr. Burns continued to the target and bombed it. A few nights later he took part in an attack on a target in Czechoslovakia. Whilst still some 200 miles from the target his aircraft was hit by anti-aircraft fire. The airspeed indicator was rendered unserviceable, but Sqn. Ldr. Burns flew on to the target, where he executed a vigorous attack.

P/O. W. S. SHERK, D.F.C., R.C.A.F., No. 35 Sqn.—One night in April, 1943, P/O. Sherk, F/O.s McGladrey and Morrison, and Sgt. Bebensee were pilot, wireless operator, navigator and flight engineer respectively in an aircraft which attacked Stettin. Whilst over the target area the bomber was struck by falling incendiary bombs. One of them, which lodged behind the pilot's seat, jammed the aileron and rudder controls. Flames and smoke rapidly filled the cockpit, and P/O. Sherk's clothing caught alight. The aircraft began to lose height, diving steeply. P/O. Sherk endeavoured to regain control, whilst F/O. McGladrey attempted to subdue the flames. Meanwhile Sgt. Bebensee struggled to free the locked controls. Just as the situation appeared hopeless the pilot regained control, and a course was set for home as F/O. McGladrey extinguished the fire. Much of the navigational equipment had been lost, but F/O. Morrison, displaying great skill, was able to plot accurate courses. Sgt. Bebensee, who worked untiringly for three-quarters of an hour, succeeded in freeing the controls. Eventually P/O. Sherk flew the badly damaged bomber back to this country.



Sqn. Ldr. J. J. Le Roux, who now has a second Bar to his D.F.C. In the official citation, on this page, he is credited with 14 aircraft.

Distinguished Flying Cross

F/O. G. G. MCGLADREY, R.C.A.F., and F/O. R. G. MORRISON, R.C.A.F., both of No. 35 Sqn.—For citations see P/O. Sherk, D.F.C. and Bar.

Act. Flt. Lt. R. G. McINNES, R.A.F.V.R., No. 40 Sqn.—This officer has completed a large number of sorties. One night in January, 1943, he displayed great tenacity when attacking an airfield in Sicily. Despite heavy fire from the ground defences, Flt. Lt. McInnes made several runs over the target before releasing his bombs. On another occasion in February, 1943, during an operation against Palermo, one of the propellers of his aircraft flew off. In spite of this, he flew back to base.

F/O. E. H. MARSHALL, R.A.A.F., No. 225 Sqn.—On one occasion in the early stages of the campaign in North Africa this officer's aircraft was shot down behind enemy lines, but F/O. Marshall succeeded in evading capture and re-joined his unit. In May, 1943, he executed a most successful reconnaissance flight which proved of great assistance to our ground forces. The next day he undertook a flight over the same area, obtaining excellent photographs in the face of considerable anti-aircraft fire.

W/O. E. J. J. SPILLER, No. 224 Sqn.—This officer has completed a very large number of hours flying on operations. During a patrol in May, 1943, his aircraft was attacked by ten Ju 88s. For nearly half an hour a running fight ensued, and W/O. Spiller displayed great skill and courage in frustrating the attackers. Although his aircraft was damaged he flew it to base, where he effected a masterly landing without the aid of brakes or flaps.

F/O. J. B. G. BAILEY, No. 431 (R.C.A.F.) Sqn.—One night in May, 1943, F/O. Bailey and Sgts. Sloan and Parslow were members of the crew of an aircraft detailed to attack Dortmund. Shortly after its bombs had been released the aircraft was badly damaged by anti-aircraft fire whilst held by the searchlights. Evasive action was taken by putting the aircraft into a steep dive, but this proved ineffective, and the bomber was subjected to heavy fire whilst still illuminated. The situation became critical, but Sgt. Sloan, displaying superb skill and determination, eventually flew clear of the defences and headed for this country.

A hatch was open and could not be closed, the rear turret door was also open, and wind of great force blew through the length of the aircraft. All the lights in the navigator's cabin were extinguished, but in the face of extreme difficulty Sgt. Parslow plotted a course. On the return flight he and F/O. Bailey assisted Sgt. Sloan in every way within their power, and eventually this gallant airman flew the badly damaged bomber to an airfield and effected a good landing.

Zeppelin Works Raid

P/O. J. McINTOSH, R.A.F.V.R., No. 207 Sqn.—This officer, who has completed many sorties, has invariably displayed outstanding determination and devotion to duty. This was amply demonstrated one night in June, 1943, when he captained an aircraft detailed to attack a target at Friedrichshafen. Shortly after taking off, one of the engines of his aircraft failed. Despite this, he continued to the target which he successfully bombed and then flew on to North Africa according to plan.

P/O. H. W. WICKMAN, R.A.F.V.R., No. 462 (R.A.A.F.) Sqn.—This officer has displayed fine qualities of leadership and judgment throughout an operational career which included the "1,000 bomber" raids and three attacks on Berlin while operating from this country. On one occasion, when detailed to attack Tobruk, his aircraft was illuminated by searchlights and one engine rendered unserviceable by anti-aircraft fire. While on the return flight and still 160 miles from base a second engine became useless. Everything possible was jettisoned and the gunners were ordered to bale out. In spite of this, a forced landing in the desert became necessary. This was accomplished so skilfully by P/O. Wickman that the aircraft sustained little further damage, and was subsequently salvaged.

W/O. R. J. MOORE.—W/O. Moore has taken part in many anti-submarine patrols and eleven bombing raids. He has been responsible for the destruction of at least one enemy submarine. In 1942 W/O. Moore sighted, initially attacked, and, in co-operation with surface units, destroyed another enemy submarine.

W/O. J. PHILLIPS, No. 248 Sqn.—W/O. Phillips has served as wireless operator on bombing raids and as navigator on operational missions along the Norwegian coast and over the Bay of Biscay. This officer has attained a very high standard in navigation, and often acts as leading navigator to the formation.

W/O. J. STRAIN, No. 489 Sqn.—W/O. Strain has completed numerous anti-shipping missions along the Norwegian coast. On two occasions this airman has attacked enemy merchant ships, obtaining direct hits with his torpedoes in the face of severe opposition.

W/O. R. N. TURNBULL, No. 89 Sqn.—W/O. Turnbull has been engaged continuously on night fighter operations for the past 2½ years. This officer has been responsible for the destruction of three enemy aircraft.

Act. Sqn. Ldr. O. D. B. COE, No. 241 Sqn.—In operations in North Africa this officer led the squadron on many bombing missions. On March 27, 1943, he participated in two attacks against Maknassy, where enemy positions were successfully bombed despite poor visibility.

Act. Flt. Lt. C. H. S. KIRKUS, No. 241 Sqn.—In the campaign in North Africa this officer participated in numerous bombing and reconnaissance sorties, rendering valuable service.

Act. Flt. Lt. E. G. NICHOLL, R.A.F.V.R., No. 241 Sqn.—This officer has completed a large number of sorties. On one occasion in March, 1943, during a bombing mission near Medjez, his aircraft was shot down between the opposing lines. Flt. Lt. Nicholl succeeded in rejoining his squadron the same afternoon and expressed a keen desire to resume flying duties immediately.

Act. Flt. Lt. F. P. MARSH, R.C.A.F., and F/O. D. W. SIMPSON, R.C.A.F., both of No. 426 (R.C.A.F.) Sqn.—One night in April, 1942, these officers were wireless operator and navigator respectively of an aircraft detailed to attack Duisburg. When nearing the target area the bomber was engaged by an enemy fighter and sustained severe damage. On the return flight F/O. Simpson displayed exceptional navigational ability in most difficult circumstances and Flt. Lt. Marsh, who skilfully obtained bearings, rendered him valuable assistance.

Act. Flt. Lt. E. C. SMITH, R.A.A.F., No. 461 (R.A.A.F.) Sqn.—Flt. Lt. Smith has completed a very large number of hours' flying on operations. On two successive days recently he executed attacks on U-boats. On the latter of these occasions a photograph taken during the operation showed debris and several of the crew in the water.

F/O. R. L. COWEY, R.A.F.V.R., No 206 Sqn—This officer has completed a large number of hours flying on anti-submarine patrols. In October, 1942, he successfully attacked a U-boat whilst on patrol over the Atlantic. Recently he sighted a lifeboat filled with survivors from a torpedoed ship and was instrumental in their subsequent rescue. During a patrol some days later he pressed home a vigorous attack on a U-boat on the surface. In spite of heavy anti-aircraft fire, F/O. Cowey succeeded in straddling the vessel with depth charges. It immediately sank, leaving several of its crew in the water.

F/O. J. M. HARTLEY, R.A.F.V.R., No. 58 Sqn.—This officer has completed many sorties. Recently he has executed three attacks on U-boats, pressing home these operations with great skill and vigour.

F/O. J. K. MOFFAT, R.A.F.V.R., No. 120 Sqn.—Whilst engaged on convoy escort duties F/O. Moffat executed a successful attack on a U-boat. In the face of anti-aircraft fire he straddled the vessel with depth charges. It sank almost immediately, leaving some of the crew in the water.

Wing Cdr. W. E. OULTON, No. 58 Sqn.—Recently this officer was the captain of an aircraft which attacked a U-boat. Later in the day another submarine was observed on the surface of the water. In the face of accurate anti-aircraft fire from the vessel, Wing Cdr. Oulton pressed home a vigorous attack. During a patrol some days later he executed a destructive attack on yet another U-boat.

Sqn. Ldr. F. H. BOULTON, R.C.A.F., No. 416 (R.C.A.F.) Sqn. (since reported missing).—This officer has taken part in a large number of sorties, including many low level attacks on targets in Northern France. He has destroyed at least four enemy aircraft.

Flt. Lt. A. G. F. OLDWORTH, R.A.F.V.R., and F/O. C. D. FAILTHORPE, R.A.A.F., both of No. 681 Sqn.—In March, 1943, these officers undertook an operational flight and achieved outstanding success. They have completed much operational flying, displaying great skill, courage and devotion to duty.

Act. Flt. Lt. R. A. BUCKHAM, R.C.A.F., No. 416 (R.C.A.F.) Sqn.—This officer has taken part in a large number of sorties and has proved himself to be a fine fighter and a first-class leader. He has destroyed four enemy aircraft and damaged five locomotives.

Act. Flt. Lt. H. D. MACDONALD (R.C.A.F.), No. 403 (R.C.A.F.) Sqn.—This officer has participated in a very large number of sorties. In addition to destroying five enemy aircraft, Flt. Lt. MacDonald has damaged three locomotives and executed vigorous attacks on other targets.

P/O. E. V. DOMONE, R.A.F.V.R., No. 409 (R.C.A.F.) Sqn.—One night in April, 1943, this officer was a member of the crew of an aircraft engaged on an offensive operation. During the flight the aircraft was hit by anti-aircraft fire and P/O. Domone was seriously wounded in the thigh. Despite intense pain and loss of blood, P/O. Domone reassured his pilot and gave him a course for base.

Flt. Lt. V. C. LOVELL, R.A.F.V.R., No. 89 Sqn. Whilst operating from Malta he has undertaken numerous sorties over enemy territory. In other operations he has destroyed three enemy aircraft.

Act. Flt. Lt. I. H. R. SHAND, R.A.F.V.R., No. 145 Sqn.—This officer has taken part in 100 sorties. During a recent flight he flew the leading aircraft of a section in support of ground forces. South of El Hamma, 12 enemy aircraft were encountered and engaged. In the ensuing combats, Flt. Lt. Shand's aircraft was attacked by eight enemy aircraft. Displaying great skill and resolution, he fought his way clear and in so doing shot down one of the attackers, although his own aircraft was hit in many places and temporarily went out of control. Flt. Lt. Shand succeeded in regaining control, however, and flew the damaged aircraft to base. This officer has destroyed two enemy aircraft.

Fifty-two Sorties

Act. Flt. Lt. J. S. FRAME, R.N.Z.A.F., No. 221 Sqn.—This officer has completed 52 sorties, including numerous successful shipping reconnaissances. One of these in October, 1942, enabled a formation to make a successful attack on a convoy of merchant vessels and their escort. During a flight in February, 1942, he located four separate convoys. In spite of fierce opposition from escorting destroyers, Flt. Lt. Frame shadowed the convoys which were later attacked by following aircraft. In April, 1942, he was detailed for a shipping search in the Trapani-Palermo area and located a convoy of four merchant ships escorted by six destroyers and five other vessels. Despite heavy fire from the convoy, Flt. Lt. Frame shadowed and reported the position of the convoys, which were subsequently attacked successfully.

Group Capt. J. R. Whitley, A.F.C., who commands a bomber station, has been awarded the D.S.O. The official citation appears on page 104.

F/O. K. J. LOVELESS, R.A.F.V.R., No. 104 Sqn.—During an operational flight one night in April, 1943, this officer displayed courage and skill of a high order. When nearing the target area one of the engines of his aircraft failed but, undeterred, he flew on and bombed his objective accurately. Displaying superb airmanship, he flew the damaged aircraft more than 250 miles over the sea to reach friendly territory and make a safe landing at an emergency airfield.

Malta Shipping Attacks

W/O. A. J. EDGAR, No. 89 Sqn.—W/O. Edgar took part in many sorties whilst based in the United Kingdom before proceeding to the Middle East, where he has fought in Libya, Malta and Tripolitania. He is an observer of great skill and has taken part in the destruction of six enemy aircraft.

P/O. J. H. LOW, R.N.Z.A.F., No. 39 Sqn.—As wireless operator/air gunner this officer has flown on 30 sorties, 23 of them from Malta. In April, 1943, he was a member of the crew of one of a formation of aircraft which attacked a convoy of four merchant ships escorted by 11 destroyers and fighter aircraft. During the run-in his aircraft was attacked by three Italian fighters, but skilful return fire by P/O. Low frustrated the attackers, thus enabling his pilot to successfully attack one of the merchant vessels. On two previous occasions, during air attacks on enemy convoys, his excellent work has contributed materially to the successes achieved.

W/O. H. VERTICAN, No. 462 (R.A.A.F.) Sqn.—W/O. Vertican has completed 40 sorties, involving attacks on targets in Greece, Crete and North Africa. On one occasion he captained an aircraft detailed to attack Lerce. The objective was successfully bombed but, whilst still over the target area, one engine of his aircraft became unservicable. Despite this, he flew the bomber back to base. Owing to the presence of thick fog, which covered a wide area, W/O. Vertican was unable to make a landing. Undeterred, he flew on, searching for another landing ground. The situation became serious and all movable equipment was jettisoned to assist in maintaining height. W/O. Vertican eventually made a landing after a flight of more than 700 miles with one of the aircraft's two engines out of action.

F/O. M. VLASTO, R.A.F.V.R., No. 81 Sqn.—In the campaign in Burma this officer completed many flights, involving the evacuation of casualties and civilians, and the dropping of supplies to our forces. F/O. Vlasto has displayed great courage and outstanding keenness. This was amply demonstrated on one occasion in April, 1943, in the execution of a hazardous flight, which he accomplished successfully.

P/O. D. J. MOULDEN, R.A.F.V.R., No. 149 Sqn.—One night in May, 1943, this officer was the pilot of an aircraft detailed to attack Bochum. After crossing the enemy coast the aircraft was intercepted on two occasions by enemy fighters, but their attacks were beaten off. When nearing

the target area the bomber was hit by anti-aircraft fire whilst illuminated by searchlights. The navigator's cabin was wrecked, incendiary bombs caught alight, while essential equipment was damaged, causing the aircraft to dive steeply. By a great effort P/O. Moulden succeeded in regaining control. On the return flight he skilfully evaded enemy fighters which attempted to attack, and eventually reached an airfield in this country and effected a masterly landing.

F/O. F. E. LEWIS, R.C.A.F., No. 7 Sqn.—In air operations these members of aircraft crew have displayed exemplary conduct and gallantry worthy of the highest praise.

Conspicuous Gallantry Medal (Flying)

Sgt. S. N. SLOAN, No. 431 (R.C.A.F.) Sqn.—For citation see F/O. Bailey, D.F.C.

Sgt. J. S. POWELL, No. 224 Sqn.—In May, 1943, this airman captained an aircraft engaged on an anti-submarine patrol. During the flight a U-boat was sighted on the surface of the water. In the face of fire from the vessel's guns, Sgt. Powell executed two vigorous attacks. Sgt. Powell was compelled to rest, as he was dazed from the concussion of a cannon shell which had burst beside his cockpit, but half an hour later he once more assumed control, and shortly afterwards two further attacks were executed on enemy submarines.

Sgt. J. P. MCGARRY, No. 70 Sqn.—One night in April, 1943, this airman was the navigator of an aircraft detailed to attack an enemy landing ground. During the operation the aircraft was hit by anti-aircraft fire. The pilot was severely wounded, while Sgt. McGarry was wounded in the leg. Despite his injury, this airman helped to remove the wounded pilot from the cockpit and afterwards rendered efficient first aid. Meanwhile, another member of the crew took over the control and Sgt. McGarry, displaying great fortitude, continued his navigational duties. In addition, throughout the return flight he tended his injured pilot. When base was reached the pilot took over the controls to attempt a landing. Sgt. McGarry was given permission to leave by parachute but elected to stay with his pilot and a successful crash landing was made near the airfield.

W/O. (now P/O.) B. W. CLAYTON, D.F.C., No. 51 Sqn.—During the course of two operational tours W/O. Clayton has participated in attacks on the enemy's most heavily defended and long-distance targets, including Hamburg, Berlin and Turin. He has always pressed home his attacks in a fearless and determined manner and has secured some excellent photographs.

Flt. Sgt. I. W. PREECE, No. 106 Sqn.—Flt. Sgt. Preece is an air gunner of proved ability, who has participated in a large number of bombing raids on enemy targets in Europe and the Middle East. Early in his operational career he completed sorties to Hamburg, Dusseldorf and Brest, and later he operated during the Western Desert Campaign against Tripoli, Palermo, Naples and Crete. On numerous occasions whilst in the Middle East he has taken part in a very commendable manner in low level machine gun attacks, firing many thousands of rounds of ammunition. In the course of the last two months he has again taken part in raids on Germany.

Distinguished Flying Medal

Sgt. D. G. BEBENSEE, No. 35 Sqn.—For citation see P/O. Sherk, D.F.C. and Bar.

Sgt. G. C. W. PARSLOW, No. 431 (R.C.A.F.) Sqn.—For citation see F/O Bailey, D.F.C.

Sgt. T. I. BODDY, No. 7 Sqn.—For citation see F/O Lewis, D.F.C.

Flt. Sgt. E. C. HOUSE, R.A.A.F., No. 450 (R.A.A.F.) Sqn.—This airman has taken part in many attacks on enemy troop concentrations and transport, bombing and machine-gunning them from a low level. During a recent sorties, an aircraft in the formation in which Flt. Sgt. House was flying was badly damaged by anti-aircraft fire. Displaying great determination, he escorted the damaged aircraft until its pilot was compelled to make a crash landing. By attacking everything in the vicinity of the crashed aircraft with machine gun fire, Flt. Sgt. House proved of great assistance to his comrade, who was thus enabled to dash to our lines in safety.

Sgt. G. OLSSON, No. 162 Sqn.—This airman has completed 27 sorties. One night in March, 1943, he was the front gunner of an aircraft engaged on an operational flight off the Italian coast. During the operation the aircraft was attacked by an enemy aircraft, and the rear gunner was fatally injured. Sgt. Olsson made his way to the rear, but was unable to extricate the rear gunner from the turret which had been rendered unservicable. He succeeded in moving his comrade's body a little to one side, however, and thus was able to observe and report the movements of three hostile aircraft flying in to attack. His commentary enabled the pilot to take effective evading action.

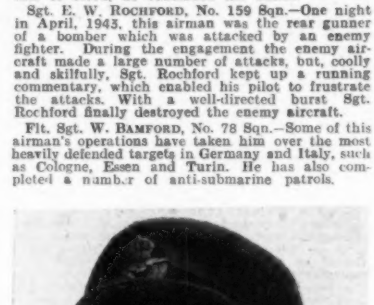
Sgt. J. C. RUDD, R.A.A.F., No. 78 Sqn.—One night in April, 1943, this airman captained an aircraft detailed to attack Stettin. On the outward flight, some 200 miles from the target, one engine of his aircraft was damaged by anti-aircraft fire and became unservicable. In spite of this, Sgt. Rudd flew on to the objective, bombed it successfully and flew the aircraft back to base.

Flt. Sgt. A. E. KINDELL, No. 107 Sqn.—In May, 1943, this airman was wireless operator/air gunner of the leading aircraft of a bomber force which attacked an airfield at Poix. During the operation fighter opposition was encountered. In the ensuing attacks Flt. Sgt. Kindell displayed exceptional skill, contributing materially to the safe return of the formation.

Sgt. G. A. COLKETT, No. 98 Sqn.—In May, 1943, this airman was the navigator of an aircraft engaged on an operational sortie. Before the target was reached, Sgt. Colkett was wounded in the leg. Although in great pain he remained at his post until his mission had been fully and successfully completed. Throughout the return flight, though in constant pain and suffering from loss of blood, he continued his duties.

Sgt. E. W. ROCHFORD, No. 159 Sqn.—One night in April, 1943, this airman was the rear gunner of a bomber which was attacked by an enemy fighter. During the engagement the enemy aircraft made a large number of attacks, but, coolly and skilfully, Sgt. Rochford kept up a running commentary, which enabled his pilot to frustrate the attacks. With a well-directed burst Sgt. Rochford finally destroyed the enemy aircraft.

Flt. Sgt. W. BAMFORD, No. 78 Sqn.—Some of this airman's operations have taken him over the most heavily defended targets in Germany and Italy, such as Cologne, Essen and Turin. He has also completed a number of anti-submarine patrols.



Sqn. Ldr. J. E. Walker, of No. 243 Squadron, who now has a second Bar to his D.F.C. The official citation is on page 104.

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Flt. Sgt. P. C. L. BIRD, No. 199 Sqn.—This pilot has completed sorties against Essen (one in daylight), Cologne and Hamburg, and also a low-level attack on a German cruiser. On one occasion, while attacking a heavily defended target in daylight, his aircraft was severely damaged by the ground defences. Despite this, he successfully dropped his bombs from a low altitude. On the way back he displayed superb airmanship in effectively evading an enemy fighter.

Flt. Sgt. L. H. BLIN, No. 97 Sqn.—Flt. Sgt. Blin has completed a second tour of operational duty. In the capacity of air gunner he has taken part in attacks on the majority of the enemy's heavily defended targets, including Berlin, Essen and Hamburg.

Flt. Sgt. C. T. BUTLER, R.C.A.F., No. 10 Sqn.—Flt. Sgt. Butler has completed a highly successful tour of operational duty. He has also obtained some excellent photographs. On one occasion he had to leave his aircraft by parachute; on two other occasions his aircraft was attacked by enemy night fighters, one attacker being destroyed each time.

Flt. Sgt. R. K. BUXTON, No. 97 Sqn.—This airman has completed many successful sorties as air gunner against the most heavily defended German and Italian targets, including Cologne, Rostock and Bremen. He has also taken part in the daylight attacks on Danzig and Le Creusot.

Flt. Sgt. R. S. CANHAM, No. 97 Sqn.—As wireless operator/air gunner, Flt. Sgt. Canham has completed a large number of operational sorties against very heavily defended targets in the Ruhr area and Western Germany. He also has taken part in the daylight attacks on Brest and Danzig.

Flt. Sgt. K. W. CHURCHILL, No. 192 Sqn.—This airman has been actively employed on operational flying since October, 1941, and has invariably displayed outstanding keenness and a fine fighting spirit.

Flt. Sgt. P. E. CLARKE, No. 76 Sqn.—This airman has completed a tour of operational duty. His sorties include attacks on Berlin, Dusseldorf, Hamburg and Duisburg. Throughout his operational career Flt. Sgt. Clarke has displayed the utmost zeal and devotion to duty.

Flt. Sgt. J. W. COLBERT, R.N.Z.A.F., No. 57 Sqn.—Since being posted to this squadron, Flt. Sgt. Colbert has taken part in many missions, including the daylight raids on Le Creusot and Milan, two attacks on Berlin, and others on the heavily defended targets in the Ruhr.

Flt. Sgt. P. G. CROSS, No. 97 Sqn.—Flt. Sgt. Cross has completed a second tour of operational duty, during which he has made attacks on some of the most heavily defended German and Italian targets, including Berlin, Essen, Hamburg and Milan.

Flt. Sgt. R. CROSSGROVE, R.N.Z.A.F., No. 57 Sqn.—Flt. Sgt Crossgrove has completed a large number of operational sorties. Amongst the targets which he has attacked have been the heavily defended centres of the Ruhr, Hamburg and Berlin.

Flt. Sgt. C. A. DAVIDSON, No. 196 Sqn.—Flt. Sgt. Davidson, now on his second tour of operational duty, has completed a very large number of operational sorties, involving attacks on some of the enemy's most heavily defended targets. In March, 1943, Flt. Sgt. Davidson's aircraft was involved in a collision with another aircraft over the Dutch coast. It was largely owing to this airman's coolness and efficiency that his captain was able to continue and successfully complete the mission.

Flt. Sgt. (now P/O.) C. J. DONAHUE, R.C.A.F., No. 97 Sqn.—Flt. Sgt. Donahue has taken part in a large number of operational sorties against German and Italian targets. He also took part in the daylight raids on Danzig and Milan.

Flt. Sgt. K. J. EDINGBOROUGH, No. 21 Sqn.—This airman has always displayed the greatest keenness to take part in operations and his excellent example has helped to maintain the fighting efficiency of the squadron.

Flt. Sgt. O. FITZPATRICK, No. 196 Sqn.—As wireless operator/air gunner, Flt. Sgt. Fitzpatrick, now on his second tour of operational duty, has completed a large number of operational sorties, the majority being against heavily defended German targets, including one daylight raid on Emden. On one occasion in March, 1943, when Flt. Sgt. Fitzpatrick's aircraft collided in mid-air with another aircraft, it was largely owing to this airman's coolness and skill that his captain was enabled to continue and successfully complete the mission.

Flt. Sgt. H. GOODWIN, R.C.A.F., No. 61 Sqn.—Throughout a very successful tour of operations Flt Sgt. Goodwin has shown outstanding ability as a pilot. This airman has attacked a wide variety of targets in Germany and Italy, including some of those which are heavily defended.

Flt. Sgt. F. HAY, No. 466 (R.A.A.F.) Sqn.—As air gunner, Flt. Sgt. Hay has completed a large number of operational sorties involving a wide variety of targets, including objectives at Hamburg, Cologne, Dortmund, Rostock, Lubeck and Essen. He has also taken part in four daylight attacks on Brest and an attack on the *Scharnhorst* and *Gneisenau* at sea.

Flt. Sgt. G. C. HAYCOCK, No. 50 Sqn.—Flt. Sgt. Haycock has always displayed the greatest keenness to fly on operations. He has taken part in attacks against the majority of Germany's most heavily defended targets.

Point-blank Searchlights

Flt. Sgt. W. L. H. HILL, R.C.A.F., No. 10 Sqn.—This airman, now employed as a gunnery instructor, has completed a tour of operational duty. On one occasion early in his operational career, during a mining operation, Flt. Sgt. Hill shot out two searchlights in the face of almost point-blank enemy ground fire which seriously damaged his aircraft. In March, 1943, as tail gunner this airman, in a remarkably cool manner, directed evasive action when his aircraft was heavily attacked by a Me 109. A month later, when his aircraft was again attacked by a Me 110, Flt. Sgt. Hill, after a combat lasting several minutes, delivered a long burst of fire, causing the enemy aircraft to disappear out of control.

Flt. Sgt. G. B. HOLLAND, No. 218 Sqn.—In December, 1942, the bomber in which this airman was flying as rear gunner was attacked five times by enemy fighters. After several bursts from Flt. Sgt. Holland's guns, at least one enemy aircraft went down in flames. During other sorties he attacked and damaged several locomotives. His objectives have included centres such as Berlin, Duisburg and Cologne, where he has met very heavy enemy opposition.

Flt. Sgt. J. L. R. HOULSTON, No. 51 Sqn.—Flt. Sgt. Houlston has been flying on operations since December, 1940, and has attacked some of the enemy's most heavily defended targets, including Cologne, Berlin, Dusseldorf, Hamburg and more recently Frankfurt, Stuttgart and Stettin. He also took part in three "thousand bomber" raids and has flown on six anti-submarine patrols over the Bay of Biscay.

Flt. Sgt. D. M. HOWIE, R.A.A.F., No. 467 (R.A.A.F.) Sqn.—In addition to attacks on most of the most strongly defended German and Italian targets, Flt Sgt. Howie took part with success in the daylight operations against Le Creusot and Milan.

Flt. Sgt. L. W. HUMPHREY, R.C.A.F., No. 97 Sqn.—Flt. Sgt. Humphrey has taken part in a large number of operational sorties, many of which have been against the enemy's most heavily defended targets in Germany and Italy.

Flt. Sgt. F. R. HUNTER, No. 166 Sqn.—This airman is an exceptional wireless operator/air gunner who has encountered many difficult and harassing situations during operations. Despite this his ability and efficiency have always been an inspiration to his crew. He has participated in bombing attacks on Essen, Emden, Bremen and in several mining missions.

Flt. Sgt. (No. P/O.) W. C. ISTED, No. 97 Sqn.—This airman has completed a large number of operational sorties. He has flown with success as navigator against heavily defended objectives in Germany and Italy, which include Bremen,

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Essen, Cologne and Genoa. He also took part in daylight operations against Brest, Le Creusot and Danzig.

Flt. Sgt. J. J. JAMIESON, No. 51 Sqn.—Flt. Sgt. Jamieson has completed many bombing raids and anti-submarine patrols while serving with this squadron. The targets which he has attacked include Hamburg, Cologne, Berlin and Essen.

Flt. Sgt. V. KEARNEY, No. 207 Sqn.—As navigator, Flt. Sgt. Kearney has taken part in a large number of operational sorties against some of the enemy's most heavily defended targets, such as Essen, Duisburg, Hamburg and Berlin. In addition he also participated in the daylight operations against Le Creusot and Milan.

Flt. Sgt. D. B. KING, R.C.A.F., No. 97 Sqn.—This airman has completed a large number of attacks on heavily defended targets in Germany and Italy. As bomb aimer he has invariably performed his duties with great courage and determination.

Flt. Sgt. J. A. KIRBY, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—During his operational tour, Flt. Sgt. Kirby has completed his duties in a cool and efficient manner, at all times keeping a vigilant watch for night fighters, which, on occasion, has been effective in avoiding unfortunate encounters.

Flt. Sgt. A. MacN. LAUGHLAND, R.C.A.F., No. 214 Sqn.—Flt. Sgt. Laughland has served as mid-upper gunner for a considerable period. He has completed numerous sorties against enemy targets, including Essen, Genoa, Turin and Hamburg. On several occasions he has skilfully fought off the attacks of night fighters, four of which he has damaged. In August, 1942, the aircraft in which he was flying was attacked by four enemy fighters. Flt. Sgt. Laughland fired at the first and set it on fire. The second broke off the attack after being hit.

Flt. Sgt. L. G. LAWSON, R.A.A.F., No. 35 Sqn.—With a large number of operational sorties to his credit, Flt. Sgt. Lawson has proved himself to be a most capable and efficient air gunner. Throughout all his operations, which have included attacks on Essen, Hamburg, Berlin, Turin and Milan, his conduct has been exemplary.

Flt. Sgt. N. E. J. LINNETT, No. 97 Sqn.—This airman has taken part with success in numerous operational sorties against Essen and other very heavily defended centres in the Ruhr and Western Germany. He has also completed operations against targets in Italy, including the daylight raid on Milan.

Flt. Sgt. I. L. McCALL, No. 57 Sqn.—On several occasions this airman has been employed as rear gunner in aircraft which have been intercepted by enemy night fighters.

Flt. Sgt. J. C. MCKNIGHT, No. 35 Sqn.—Whenever circumstances have called upon Flt. Sgt. McKnight to secure the successful completion of the mission upon which he has been engaged, he has always responded with very commendable coolness and skill.

Flt. Sgt. E. McNEVIN.—Flt. Sgt. McNevin has completed a large number of operational flights against long distance and heavily defended targets in Europe. On all occasions he has displayed great courage and devotion to duty.

Flt. Sgt. (now P/O.) I. M. MARSHALL, No. 9 Sqn.—Flt. Sgt. Marshall has completed a tour of operational duties. He has completed operational missions against objectives which have included Berlin, Milan, Bremen and other strongly fortified centres in enemy territory.

Flt. Sgt. (now P/O.) C. MAYLAND, No. 97 Sqn.—Flt. Sgt. Mayland has completed numerous operational missions against the most heavily defended objectives in Germany and Italy. These have included sorties against Cologne, Hamburg, Kiel and Essen, and the daylight raids on Le Creusot and Milan.

Flt. Sgt. MERRALLS, No. 97 Sqn.—This airman has participated in many successful attacks against targets in Germany and Italy, many of them being very heavily defended. He also took part in daylight attacks on Brest, Augsburg and Milan.

Flt. Sgt. A. A. MUNRO, No. 61 Sqn.—This airman has flown on the majority of his operational sorties in the capacity of air gunner to his flight commander. He has taken part in raids on targets in Bremen and Essen, and also Italian objectives, including the daylight raid on Milan.

George Medal

Group Capt. S. GRAHAM, M.C.—In March, 1943, a Wellington aircraft overshot when landing and crashed into another aircraft. The impact carried both aircraft against a hangar, where they burst into flames. Group Capt. Graham was on the scene immediately. Disregarding the danger from exploding ammunition, petrol tanks and oxygen bottles, and although he was aware that one of the aircraft carried a 250 lb. bomb, he led the rescue party in extricating three members of the crew from the blazing aircraft. Group Capt. Graham then led the fire-fighting party in an endeavour to save the burning hangar. He was attacking the fire, which had spread to the offices of the hangar, when the bomb on the aircraft, less than eight feet away, exploded. With his face badly cut by splintered glass and flying debris, and bleeding profusely, he was persuaded to go to the station sick quarters, where he made light of his injuries and inspired others who had been injured by the explosion. After receiving first-aid treatment, he returned to the scene of the accident and directed operations until the fire had been subdued.

Escort-carrier H.M.S. *Archer*, which has distinguished itself in the Battle of the Atlantic. Citations of two awards of the D.S.C. and one of the D.S.M. to members of the ship's aircrews appear on page 104.

Military Medal

A/C.1 L. G. BULLEN, R.A.F. Regiment.—In November, 1942, this airman, with his flight, was on the coastal road proceeding in the direction of Sollum. When the convoy had reached a point at which the road was crowded with transport vehicles, an enemy bomber approached, dropping bombs which caused casualties. A/C. Bullen, with great presence of mind and coolness, manned his gun, which was mounted on a lorry, and successfully shot down the intruder before further damage was done. In December, 1942, he repeated this feat, destroying an enemy aircraft which was making a low-level attack on dispersed aircraft.

Roll of Honour

Casualty Communiqué No. 256.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 102 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. J. Baker; F/O. R. Bastow; Flt. Lt. H. J. Blackshaw, D.F.C.; F/O. G. A. L. Broderick; F/O. C. R. George; Sgt. E. G. L. Giggs; Sgt. H. Russell; Sgt. D. A. Traill.

PREVIOUSLY REPORTED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED IN ACTION.—F/O. T. E. G. Hanson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. L. J. W. Beckman; Sgt. W. T. Belton; Sgt. F. W. Brogden; Sgt. L. Byrne; Flt. Sgt. S. Cooper; Sgt. G. A. Hill; Flt. Sgt. J. H. Hogg; P/O. J. S. Smyth; Sgt. S. G. Walton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. F. E. Allen; P/O. F. H. J. Ashton; P/O. L. P. Bales; Group Capt. P. R. Barwell, D.F.C.; Sgt. E. W. Catlin; Sgt. W. J. Chapman; P/O. G. F. Corah; Sgt. J. F. Crawford; P/O. W. L. Croxton; P/O. A. A. Delve; P/O. V. P. De Wallens; Sgt. H. Dronfield; P/O. J. S. V. Fegan; Sgt. R. W. Fisher; Sgt. J. Grant; Flt Sgt. R. G. Gumbley; Sgt. J. H. Harries; Sgt. J. Hatch; P/O. S. F. Hazleton; Flt. Sgt. F. Hobson; Sgt. J. H. Holmes; P/O. J. J. Hughes; P/O. A. E. Hull; P/O. H. Inglesby; Sgt. E. H. Jones; P/O. A. A. H. Lindley; Sgt. L. Lobb; Act. Sqn. Ldr. R. G. Lynn, D.F.C.; Sgt. J. R. McRae; Act. F/O. H. G. B. Mays; P/O. A. R. Porter; P/O. T. W. Prentice; Sgt. W. F. Reynolds; P/O. W. C. Samuel, D.F.M.; Sgt. A. J. Selby; F/O. A. Sharples; Sgt. R. T. Smith; Flt. Sgt. G. J. Sumners; P/O. D. A. Tedford; Sgt. J. L. Tolmie; Act. Flt. Ltd. R. A. Upshur; Sgt. L. Warwick; Sgt. E. S. Watson; P/O. L. H. Williams; Sgt D. J. White; P/O. J. A. Whittingham.

WOUNDED OR INJURED IN ACTION.—Sgt. W. H. Mudge; P/O. A. B. Withecombe.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. E. T. Maton.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. A. Beedim; Sgt. A. E. Emms; Sgt. D. High; Sgt. P. G. Kehl; Sgt. S. Laughlin; Sgt. R. B. Loverseed; Sgt N .A. Peachey; F/O. M. F. Scantlebury; Sgt. T. H. Skelton; Sgt. A. I. Stark; Sgt. A. Steel; P/O. J. D. Wallace; F/O. V. A. Wilson; P/O. G. Wragge.

MISSING.—Sgt. G. Adams; Sgt. W. H. D. Alison; P/O. F. A. Alp; Sgt. J. W. Armstrong; Sgt. W. H. Ayton; Cpl. R. Atkinson; Sgt. E. G. R. Beacham; Sgt. A. W. Brighurst; P/O. R. P. Bulcock; F/O. P. S. Burgess; F/O. J. L. Clegg; Sgt. F. J. Cleasby; F/O. J. R. Coates; F/O. R. H. D. Cook; P/O. E. R. Crocker; Sgt. J. Davies; F/O. S. G. Donaldson; P/O. B. P. Dougall; F/O. D. C. Duff; P/O. J. R. R. Dunlop; Sgt. L. A. Dunmore; P/O. K. P. Du Rieu; Sgt. R. Elmes; F/O. H. Enever; P/O. D. W. H. Evans; Flt. Sgt. P. Fennel; Sgt. J. Fitton; Sgt. J. Gale; P/O. B. A. A. Geale; Sgt. A. Gillespie; Wing Cdr. J. R. Gillman; Sgt. S. L. Goodwin; Sgt. F. P. C. Gower; Sgt. D. Grey; Sgt. T. Griffith; P/O. K. W. Hamilton; F/O. W. Hamilton; Sgt. G. E. Harmes; F/O. N. J. W. Harvey; Sgt. F. B. Holmes; P/O. H. P. Horne; Sgt. F. J. Howell; Sgt. N. Hudspith; Sgt. R. Hughes; P/O. C. A. Ironside; P/O. A. H. Ives; Sgt. F. Johnson; Sgt. E. Kurring; Sgt. J. R. Leigh; Sgt. W. Leven; Sgt. J. H. G. Liddell; Sgt. R. W. Littlefair; Act. P/O. R. H. MacIven; Sgt. R. C. Meyer; Sgt. K. G. Money; W/O. T. J. Moss; Sgt F. S. Neal; F/O. V. S. Neill; Sgt. S. Ogden; P/O. W. B. Paxton; Flt. Sgt. E. J. Phelps; Sgt. J. Piggott; Sgt. D. J. Richards; Sgt. D. C. Robertson; Sgt. D. H. Rock; F/O. T. H. J. Sackville; F/O. R. C. Sawyer; F/O. H. H. Siddell; P/O. J. Skinner; F/O. P. R. Smith; P/O. W. G. Simpson; F/O. P. S. Stephen; Sgt. A. McC. Sutherland; P/O. G. N. Sutton; Sgt. J. R. Thompson; Sgt. L. Waldorf; P/O. B. N. Weekes; Sgt. T. Wharmby; P/O. S. L. Whillis; Sgt. J. G. Wilson.

KILLED ON ACTIVE SERVICE.—Flt. Lt. J. E. Bartrum; Sgt. J. Fisher; Sgt. T. H. A. Knight; Flt. Sgt. J. L. Oakley; Flt. Lt. E. E. Sergeant.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. E. W. J. Blake; Sgt. J. L. Smit.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. S. G. Chalmers.

DIED ON ACTIVE SERVICE.—Sgt. R. C. Clarke; Cpl. F. H. Davies; A/C.1 C. Herdman; A/C.1 C. J. Invine; A/C.1 L. E. Norris.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. R. Atkinson; Sgt. A. Cameron; Flt. Sgt. D. D. P. Leitch; Sgt. F. R. Slocombe.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—A/CW.1 H. R. Brand; L.A/CW. M. Macaskill; L.A/CW. B. M. Stannard.

DIED ON ACTIVE SERVICE.—A/CW.2 S. J. Farraway.

Royal Australian Air Force

KILLED IN ACTION.—F/O. R. P. Lutz; Sgt. C. W. Trinder.

PREVIOUSLY REPORTED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED IN ACTION.—F/O. A. McM. Paton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. G. A. Dougall; Sgt. A. N. Glancy; Sgt. F. J. Ryan; Sgt. L. W. Thomas.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. B. G. James; Sgt. D. S. Lister.

MISSING.—Flt. Lt. R. N. G. Barlow; Sgt. R. D. Carne; Sgt. F. V. Dyson; Sgt. J. W. Lawson; Flt. Sgt. W. J. Nicholas; Sgt. R. L. Robertson; Flt. Sgt. T. G. N. Russell; F/O. C. R. Williams.

KILLED ON ACTIVE SERVICE.—P/O. L. G. Carter.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. G. M. Loughland.

Royal Canadian Air Force

KILLED IN ACTION.—F/O. W. B. Gibbs; F/O. R. W. Haven; F/O. J. MacL. Hogg; F/O. W. W. Nichol; F/O. C. L. Stevens.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. P. Cushing; Flt. Sgt. W. Linwood; Flt. Sgt. H. D. MacPhee; Flt. Sgt. J. T. Ratcliffe; P/O. A. D. Walker; Sgt. A. C. Yates.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. D. Alley; Flt. Sgt. J. E. Cole; Flt. Sgt. W. E. N. Field; Sgt. W. H. Gardner; Flt. Sgt. W. G. Gibson; Sgt. F. W. Hough; Flt. Sgt. H. J. Kirkpatrick; P/O. N. L. Laing; W/O. D. B. McGrath; Sgt. W. J. A. McLachlan; Flt. Sgt. W. L. Maxim; Flt. Sgt. A. E. Nickerson; Flt. Sgt. B. V. Pearce; Flt. Sgt. F. G. Peebles; P/O. D. H. Peters; Sgt. J. S. Peterson; W/O. W. T. Sargant; Flt. Sgt. M. A. Schofield; W/O. W. L. Scott; Sgt. F. W.

SERVICE AVIATION

Stewart; Flt. Sgt. W. Tait; Sgt. J. A. Thompson; Flt. Sgt. D. L. Torkelson; Sgt. F. M. Van Geun; Sgt. A. Yankoski.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. W. H. Bowden; Sgt. C. L. Gerding P/O. E. C. Hallding; Sgt. O. J. Haralson; F/O. L. W. Jones; Sgt. T. Lafontaine; P/O. W. T. Lane; Sgt. L. D. McEwen; Sgt. L. Nutik; Sgt. H. J. Salisbury; Sgt. H. Sobel; Sgt. W. G. Uttley.

MISSING.—P/O. R. L. Baumgarten; P/O. R. J. Bryans; P/O. J. A. Calder; F/O. O. M. Cornish; Sgt. R. T. Grimmins; P/O. L. A. Dingley; Sgt. J. P. O. Ethier; Sgt. K. L. Garman; F/O. H. E. Glinz; Sgt. A. E. Hatch; Sgt. C. C. Hildreth; Sgt. W. H. Hill; Sgt. A. F. Hopley; Sgt. D. R. Horwood; Sgt. T. F. How; Sgt. P. G. Kelly; Sgt. E. E. Lundy; Sgt. A. F. McCoy; Sgt. C. W. McKim; W/O. G. A. McMillan; Sgt. W. E. Mann; Flt. Sgt. D. S. Mitchell; P/O. W. W. O'Brien; Sgt. W. N. Partridge; P/O. E. B. Ruto; Act. Flt. Lt. J. Sale; P/O. H. A. Tennis; Sgt. J. A. Thomson; Flt. Sgt. J. S. Vose; P/O W. Wahl; Sgt. S. L. R. Whitehead.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. O. P. Downey; Sgt. J. R. Hill; Flt. Sgt. D. D. Maclean; F/O. J. E. Rylands.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. D. A. M. Davidson; Sgt. W. C. Hutchison.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. S. S. Mitchell.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. R. G. Lindsay.

KILLED ON ACTIVE SERVICE.—Sgt. G. C. N. Miller.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—2/Lt. G. B. Callaghan.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Lt. H. Gahler.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Lt. D. F. Symonds.

Casualty Communiqué No. 257.

Of the names in this list 98 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Act. Flt. Lt. A. J. F. Allen-White; Sgt. J. W. Atkinson; Sgt. F. J. C. Barnes; Sgt. L. C. Cartwright; Sgt. I. W. Chance; Sgt. M. C. Colwill; Sgt. L. Cowen; Sgt. A. G. Dunn; Sgt. R. E. Evans; Sgt. K. Forster; Sgt. J. C. Havenhand; Flt. Sgt. J. Jack; Sgt. T. C. F. Orr; Sgt. C. Riches; Sgt. K. Yates; Sgt. S. G. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. E. W. Baker; P/O. H. W. Blackford; Sgt. J. J. Bowles; P/O. E. D. Calvert; P/O. S. A. Cheeseman; Sgt. G. B. Cranshaw; Flt. Sgt. G. K. Dickenson; Sgt. R. Dicks; Sgt. E. Downs; Sgt. J. W. Flint; Sgt. A. H. G. Genny; Sgt. A. I. Gottlieb; Sgt. H. S. Greenwood; Flt. Sgt. F. Hagger; Sgt. K. Hawthorne; Sgt. J. V. Holland; Act. Flt. Lt. H. Jackson; Flt Sgt. G. P. Jones, D.F.M.; Sgt. L. H. Lavis; Sgt. J. O. Ludgate; Sgt. J. W. Moss; P/O. D. F. Nicholson; Sgt. A. G. Oswin; Flt. Sgt. R. G. Page; Sgt. C. V. Pattison; Sgt. G. V. Payne; P/O. A. H. Pontius; P/O. W. N. Ramage; Sgt. R. F. Reynolds; P/O. J. M. Rickard; Flt. Sgt. J. L. Salisbury; Sgt. L. A. Sargan; Sgt. P. D. Sherman; Flt. Sgt. E. Topping; Sgt. W. H. Trottier; Sgt. P. Van-Lelyveld; Sgt. S. J. Vickery; Flt. Sgt. H. J. Wade; P/O. G. J. Waller; Sgt. S. Watson; Sgt. H. E. A. Willey.

WOUNDED OR INJURED IN ACTION.—Sgt. A. E. V. Rainger.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. G. E. Leedham.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. E. G. Bass; F/O. A. C. Bonner; Sgt. E. D. Harrison; Sgt. M. C. Jeffries; P/O. R. F. Kingham; Sgt. P. J. Lavin; P/O. E. C. North; Sgt. A. H. M. Schofield; Sgt. H. Sweet; Flt. Sgt. D. H. Williams.

MISSING.—Flt. Lt. W. Astell, D.F.C.; Flt. Lt. J. E. Atkins; Sgt. B. A. Bacon; Sgt. D. A. Ball; Sgt. J. J. H. Barter; Sgt. R. Bell; Sgt. S. Biddulph; Sgt. R. Bolitho; Act. Flt. Sgt. D. B. Bourne; Sgt. J. E. Boyes; Sgt. A. J. Buxton; Act. Flt. Sgt. T. R. Cairns; Sgt. A. Camps; Flt. Lt. G. A. Church; Sgt. C. V. N. Cogdell; Sgt. G. T. Cook; Sgt. R. L. Deacon; Sgt. W. E. Delaney; Sgt. W. J. Dewson; F/O. H. E. Dowle; Sgt. W. Dunkerley; Sgt. E. D. Dwelly; Flt. Sgt. R. W. Easton; Sgt. A. V. Edwards; Sgt. E. W. Eke; Sgt. R. D. Evans; W/O. J. Friendly, D.F.M.; Sgt. C. Green; Sgt. T. J. Gregory; F/O. A. C. M. Griffin; Sgt. E. W. Hall; Sqn. Ldr. V. R. G. Harcourt, D.F.C.; Sgt. L. G. Hardy; Flt. Sgt. S. A. Hathaway; P/O. A. J. Hendry; Sgt. S. E. Herbert; F/O. A. J. Hibberd; Sgt. K. G. Higgs; P/O. R. E. Hope-Faulkner; F/O. D. Hopkinson; Flt. Lt. I. MacD. Horobin; Wing Cdr. E. M. T. Howell; Sgt. K. Hubbard; Sgt. G. M. Hughes; Sgt. A. James; Sgt. S. James; Sgt. S. Jepson; Flt. Sgt. W. A. Jones; Sgt. K. M. Jordan; Sgt. J. Kinnear; F/O. W. L. Leeman; P/O. G. W. Locksmith; Flt. Sgt. J. MacAulay; F/O. G. O. M. Massip de Turville; Sgt. T. G. Matthews; W/O. E. J. Maycock; Sgt. F. Miller; Sgt. A. M. Morgan; Sgt. F. A. Morris; Sgt. W. Murray; F/O. T. A. Newbery; Sgt. J. G. Newell; Sgt. J. I. Noble; F/O. T. Noble; Sgt. S. Owen; P/O. F. H. Pennifold; Flt. Sgt. H. Plant; Flt. Sgt. J. Reynolds; Act. Flt. Lt. L. A. Rickinson, D.F.C.; Sgt. H. A. Roberts; Sgt. D. H. Robinson; Flt. Sgt. J. A. Rolfe; Sgt. E. Rome; Sgt. K. G. Roots; Sgt. D. B. Sach; Sgt. F. G. Salter; Sgt. C. C. D. Scotney; Sgt. R. S. Shaw; Sgt. W. H. A. Shelvington; Sgt. C. E. Sheppard; Flt. Sgt. D. Smart; Sgt. A. G. Smith; Sgt. T. Smith; Sgt. J. A. Stephens; Sgt. C. E. Tomlin; P/O. H. Tunstall; Sgt. L. Urry; Sgt. G. H. Wager; Sgt. J. S. Warburton; F/O. R. L. Wellington; Sgt. D. F. West; Sgt. E. M. Whitsed; Sgt. A. R. Williams; Sgt. J. Woods.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—L.A/C. C. A. W. Bailey; L.A/C. R. Chawshaw; A/C.2 R. J. Wood.

KILLED ON ACTIVE SERVICE.—Sgt. T. J. Campbell; Sgt. G. A. Cure; Sqn. Ldr. C. R. Elgar; P/O. E. G. Farrow; L.A/C. H. K. Genge; Sgt. J. Hedge; Flt. Lt. M. C. Knight; L.A/C. V. Monaghan; A/C.1 J. J. Morrissey; Cpl. W. J. Peregrine; L.A/C. R. R. Smith; P/O. H. J. Wallace; F/O. J. H. G. Watson; L.A/C. R. Taylor.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. J. H. Barton; Sgt. J. F. Maher; Sgt. J. G. Stuckless.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. W. Ashby; A/C.2 W. H. Bevan; Sgt. S. W. Eckersley; L.A/C. N. S. Hart; L.A/C. R. T. Heskins; L.A/C. J. G. Hill. MacDonald; L.A/C. W. W. Pass; L.A/C. C. B. Scott; L.A/C. E. G. Steward; L.A/C. C. E. Williams.

DIED ON ACTIVE SERVICE.—Cpl. J. Allison; A/C.2 H. E. Baker; L.A/C. J. H. Boucher; Sgt. J. Brason; Cpl. N. J. Case; L.A/C. H. E. Creasey; L.A/C. R. G. Earl; F/O. D. C. Houle; L.A/C. W. H. James; A/C.1 G. S. Jones; P/O. A. H. Moore; L.A/C. R. H. Rushworth; Cpl. T. W. Southwick; L.A/C. D. Speirs; A/C.2 G. N. Stainton.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.1 P. E. Lane.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. J. C. Luton.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. D. Hill; F/O. R. G. Rowlands.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. C. E. T. Bartram; Sgt. C. T. Bingham; A/C.1 N. T. Cuddihy; Sgt. H. H. Feally; P/O. E. F. H. Frith; Sgt. H. R. McGowan; P/O. A. R. Meaker; Sgt. J. R. Mullins; P/O. G. A. Neill.

MISSING.—Flt. Sgt. W. L. Gibbs; Act. Flt. Lt. H. D'A. Ransome, D.F.C.

THOR UNDER TEST : A Thunderbolt firing its eight 0.5in. machine guns into the stop butts.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. S. W. Bartlett.

KILLED ON ACTIVE SERVICE.—Sgt. H. M. Atherton; Sgt. D. P. Boyle; Sgt. R. J. Miller; Flt. Sgt. A. J. Webb.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. B. Boyton.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. L. W. Collins; Sgt. W. W. Nolan.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. C. E. Bayliss; F/O. W. D. Finlason.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. T. P. Allenby; P/O. R. J. Cartmell; Sgt. S. S. Glasscock; P/O. H. E. Orr; Sgt. J. D. Rae; Sgt. J. G. Spouler.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. L. M. Beaumont; Sgt. R. T. J. Collett; Sgt. C. D. Dixon; P/O. W. MacM. Fraser; Sgt. B. L. Kohn; P/O. G. C. McDonald; Sgt. D. Mathieson; Sgt. P. C. Omlyianowski; Sgt. R. N. Parham; W/O. G. Slott; Flt. Sgt. R. Sillis; P/O. B. A. Trapp; P/O. J. E. Wilkes.

MISSING.—Sgt. J. C. Archer; Flt. Sgt. F. G. Baker; Sgt. R. V. Clitheroe; Sgt. W. E. Douglas; Sgt. C. W. Ellard; Sgt. R. D. Fraser; Sgt. F. A. Garbas; Sgt. A. Garshowitz; Sgt. J. Gedak; P/O. W. A. Grant; Flt. Sgt. A. L. Home; Sgt. G. A. P. Johannesson; Sgt. J. P. Keating; Sgt. J. R. Keeping; Sgt. M. G. T. Levins; P/O. H. C. MacNeil; P/O. R. G. Madge; Flt. Sgt. G. J. McEachern; Sgt. K. H. Masterson; Sgt. M. R. E. Metcalfe; Sgt. W. Morey; Sgt. D. C. Nault; Sgt. W. G. Pepper; P/O. J. B. Pettigrew; F/O. D. Pratt; Flt. Sgt. L. A. Rivest; Sgt. H. A. Sheehan; Sgt. L. G. Sutherland; Sgt. G. W. Thompson; P/O. R. E. Wagner; Flt. Sgt. N. J. Waters; P/O. F. A. Wile.

KILLED ON ACTIVE SERVICE.—Sgt. G. Belec.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. R. E. McRitchie.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. R. A. Lockhart.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. F. P. J. Bolger.

DIED ON ACTIVE SERVICE.—F/O. G. J. Butler.

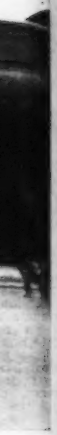
PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—F/O. E. R. Derick.

Royal New Zealand Air Force

KILLED IN ACTION.—F/O. O. W. Thompson, D.F.M.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. W. Murphy.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. J. Wakeman.

MISSING.—P/O. I. H. Alexander; P/O. E. A. G. Cochrane; F/O. D. R. Hall.

DIED ON ACTIVE SERVICE.—W/O. A. R. Cook.